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ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

RMRS Rocky Mountain Remediation Services L.L.C

FINAL

SOURCE EVALUATION REPORT FOR RFCA POINT OF COMPLIANCE GS08

WATER YEARS 2000-2001

May, 2001

1/38

RF/EMM/WP-01-002 UN
Revision 0

Source Evaluation Report for RFCA Point of Compliance GS08 Water Years 2000-2001

FINAL

May, 2001

U S Department of Energy
Rocky Flats Environmental Technology Site
Golden Colorado

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1 EXECUTIVE SUMMARY

Rocky Flats Environmental Technology Site (Site) personnel have completed the investigation of the possible cause(s) of reportable 30-day moving average values for plutonium[1] at the Rocky Flats Cleanup Agreement (RFCA) Point of Compliance (POC) monitoring location GS08 (Figure 1 1) First reported on December 12 2000 (00 DOE-04205) the reportable values may be summarized as

- Reportable values were observed at the POC monitoring location at the Pond B 5 outfall (referred to as GS08) for September 14 2000 and the period November 21 24 2000

When reportable values are measured at a POC RFCA requires the Department of Energy (DOE) to notify the RFCA parties and submit a plan for source evaluation This Source Evaluation report is provided in accordance with the proposed actions outlined in the Plan for source evaluation dated December 28 2000 (00 DOE-04330)

This report for the recent reportable period contains no specific recommendations for mitigating actions since no localized sources warranting remedial action have been identified [2] The recommended course of action in this report will not compromise protection of human health and the environment since water-quality measurements at the Site boundary (POC GS03) showed levels of Pu well below the reporting threshold

The Site s current proposed course of action includes continued environmental monitoring and progress on the Actinide Migration Evaluation (AME) project Effective best management practices such as the use of the existing terminal ponds in batch or flow through mode to clarify stormwater of potentially contaminated sediment and particulate matter should be continued Specifically the Site proposes the following actions as the path forward

- Continued monitoring and ongoing data interpretation (especially the ongoing GS10 source evaluation) to provide a better understanding of actinide transport directly related to the operation of the Site automated surface water monitoring network
- Continued progress on the AME as a longer term technical study to provide understanding of actinide migration that may eventually provide insights into the cause(s) and possible prevention of reportable radionuclide water-quality measurements
- Continued use of the existing detention ponds to clarify stormwater of potentially-contaminated sediment and particulate matter as an effective best management practice
- Continued reporting through AME reports Quarterly RFCA Reports Quarterly State Exchange Meetings and informal technical briefs

[1] In this report plutonium and Pu refer to Pu 239 240 Similarly americium and Am refer to Am 241

[2] Future remediation activities scheduled for the Site (especially within the GS10 sub drainage) may positively influence water-quality at GS08

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Figure 1 1 Location Map for RFCA POC GS08

See attached map

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2 BACKGROUND

2 1 GS08 Monitoring Results

As specified in the Surface Water section of the Integrated Monitoring Plan (IMP) Site personnel periodically (semi monthly) evaluate 30-day moving averages for selected radionuclides at RFCA Points of Evaluation (POEs) and POCs Recent evaluations of water-quality measurements at POC surface water monitoring location GS08 (see Figure 1 1) show values for plutonium requiring reporting and source evaluation under RFCA Results for 30-day moving averages[3] using available data at GS08 are summarized below in Table 2 1 and are plotted in Figure 2 1

Table 2 1 Water-Quality Information from GS08 for the Period 10/1/99-3/11/01

Location	Parameter	Date(s) 30-Day Moving Average Requiring Reporting	Date of Maximum 30 Day Moving Average	Maximum 30 Day Moving Average (pCi/L)	Volume Weighted Average for Water Year[4] 2000 – 3/11/01 (pCi/L)
GS08	Pu 239 240	9/14/00 11/21 – 11/24/00	11/24/00	0 154	0 034

The laboratory narratives for the individual analytical results for the composite samples collected around the period of these reported 30-day moving averages have been reviewed and offer no reason to question the accuracy of these results These results have also received formal third party validation (Section 4 1) Since the initiation of RFCA monitoring at POC GS08 there have been two Pu sample results above 0 15 pCi/L For the same period there was a single Am sample result above 0 15 pCi/L (Figure 2 2) Of these only the Pu result dated 8/11/00 resulted in a reportable 30-day average activity (Table 2 2) In all three cases the analytical results from composite samples collected immediately prior were all significantly less than the minimum detectable activities (MDA) Individual composite sample results and details are shown in Table 2 2 for the period of interest Figure 2 2 shows the mean-daily flow rates with the individual composite sample results from GS08

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[3] The 30 day moving average activity (pCi/L) for a particular day is calculated as a volume weighted average for a window of time containing the previous 30-days which had flow Each day is assigned the activity of the composite sample that was filling at the end of that day (specifically 23 59) Each day has a corresponding measured discharge volume in liters which is multiplied by the assigned activity to obtain daily load in pCi The equation for the 30 day window can be written as follows

$$\frac{\sum_{day\ 1}^{day\ 30}[picocuries]}{\sum_{day\ 1}^{day\ 30}[liters]} = 30day\ Average_{day\ 1}[pCi/L]$$

When a negative result is returned from the lab due to blank correction a value of zero pCi/L is used in the calculations Therefore there are 365 30-day moving average values for a location that flows all year (366 in a leap year) For days where no activity is available either due to failed laboratory analysis or non sufficient quantity for analysis (NSQ) no 30 day average is reported

[4] A water year (abbreviated as WY) is defined as the period from October 1 through September 30th

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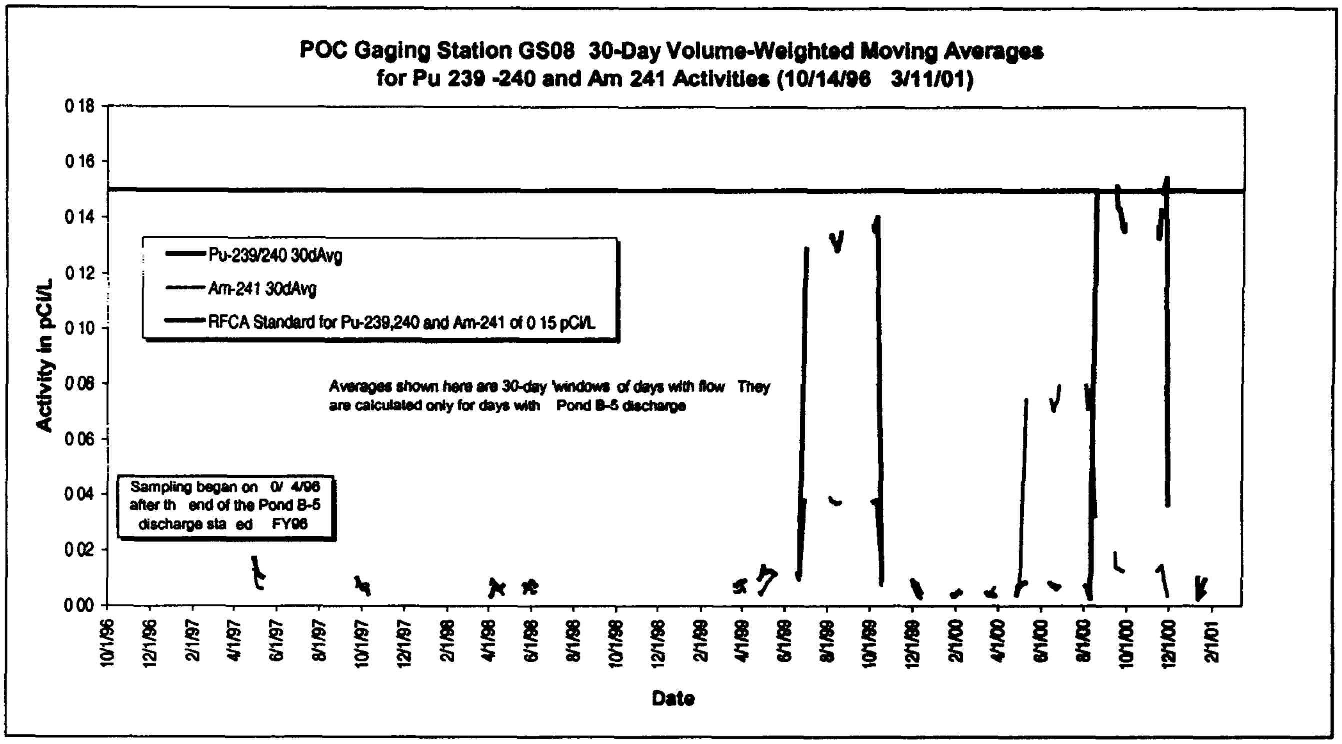

Figure 2 1 Gaging Station GS08 30-Day Moving Averages 10/1/96 – 3/11/01

Table 2 2 Selected Composite Sample Analytical Results for GS08.

Composite Sample Period	Pu 239,240 (pCi/L)		Am 241 (pCi/L)		Composite Sample Volume (Liters)	B-5 Discharge Volume During Sample Period (Million Gallons)
	Result	Error	Result	Error		
8/3 – 8/7/00	0 004	0 014	0 005	0 005	12 6	7 44
8/7 – 8/11/00	0 005	0 009	0 041	0 023	9 8	4 36
8/11 – 8/17/00	0 864	0 124	0 043	0 026	10 0	4 84
9/14 – 9/19/00	0 002	0 011	-0 001	0 014	9 8	6 04
9/19 –9/26/00	0 007	0 008	0 007	0 006	16 8	9 23
11/13 – 11/17/00	0 007	0 009	0 006	0 013	10 0	4 77
11/20 – 11/29/00	0 007	0 009	0 003	0 012	16 6	7 87

Note All compos te samples listed abo e were of adequate olume for all required analyses

Water discharged from Pond B 5 to Walnut Creek subsequently flowed through RFCA POC GS03 at Walnut Creek and Indiana Street (Figure 2 3) Analytical results from composite samples collected at GS03 for the period under review were all well below the RFCA standard (Figure 2-4 and Figure 2 5)

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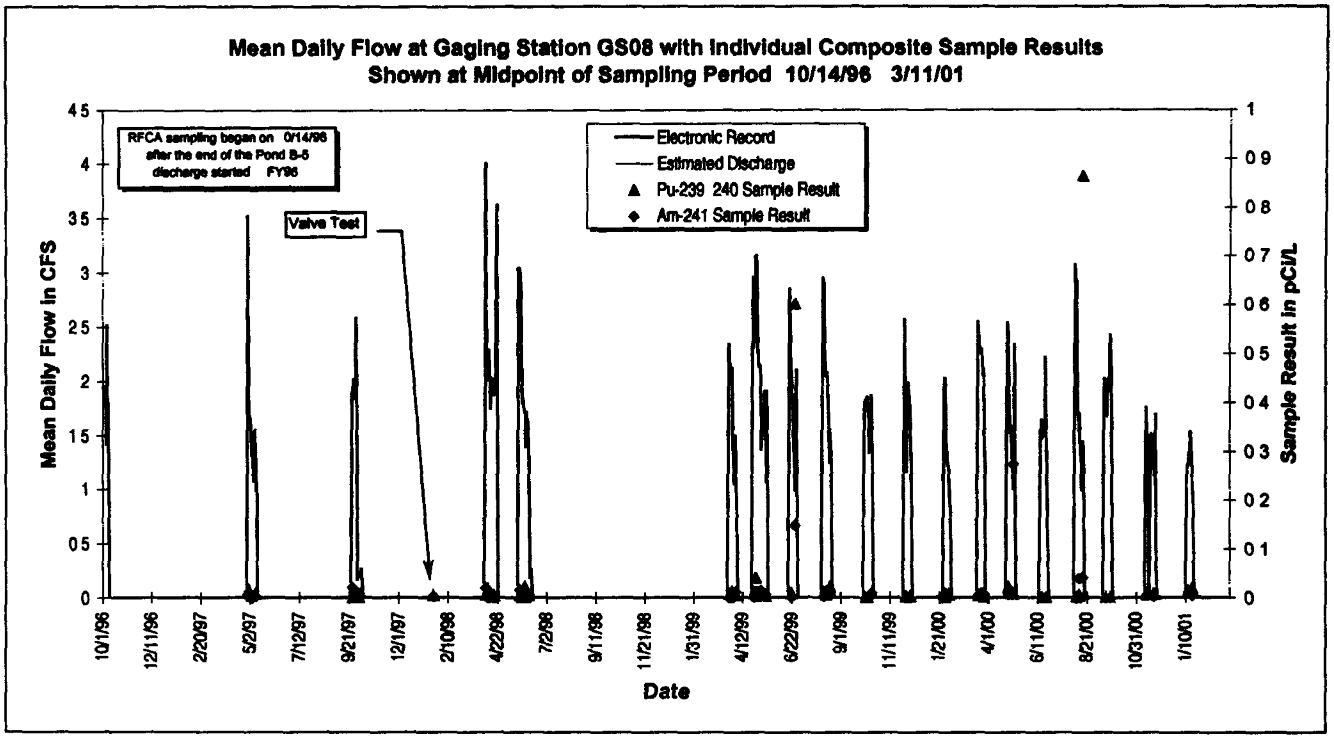
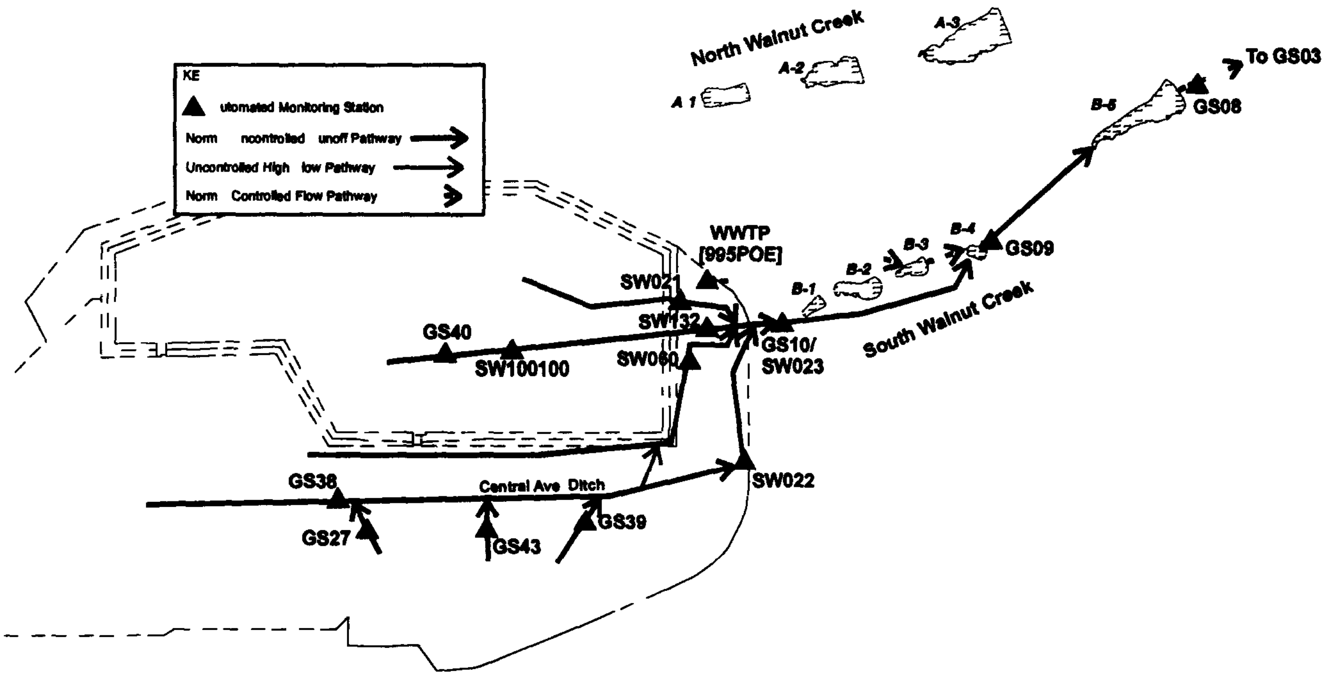


Figure 2 2 Gaging Station GS08 Hydrograph and Sample Results



Note The Wastewater Treatment Plant (WWTP) is also identified as 995 (Bu lding 995) n this document Sampling of the WWTP effluent has been conducted at location codes 995EFF and 995POE Ponds B 1 and B 2 are ot tributary to GS08 any water llectı g B 1 normally tra sferred to B 2 with water B 2 ormally bei g transferred to Pond A 2

Figure 2 3 Hydrologic Routing Schematic for POC GS08

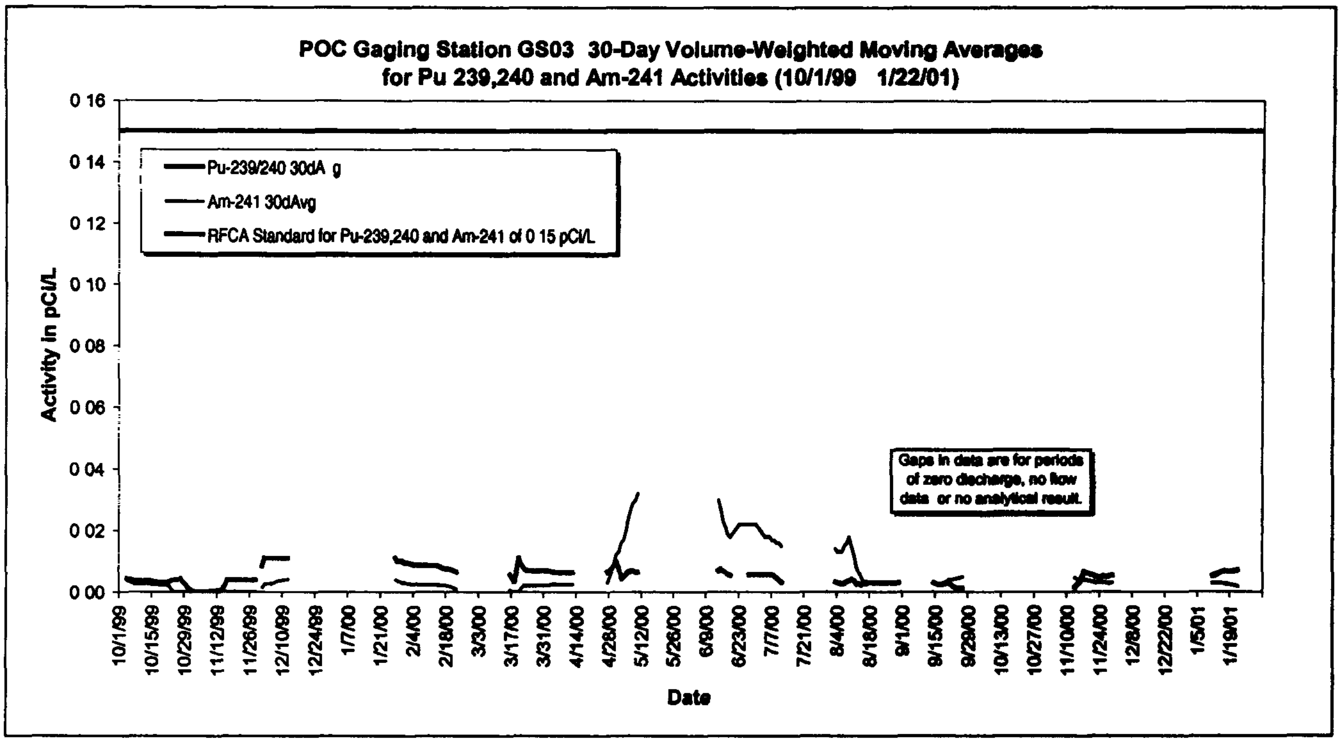


Figure 2-4 Gaging Station GS03 30-Day Moving Averages 10/1/99 – 1/22/01

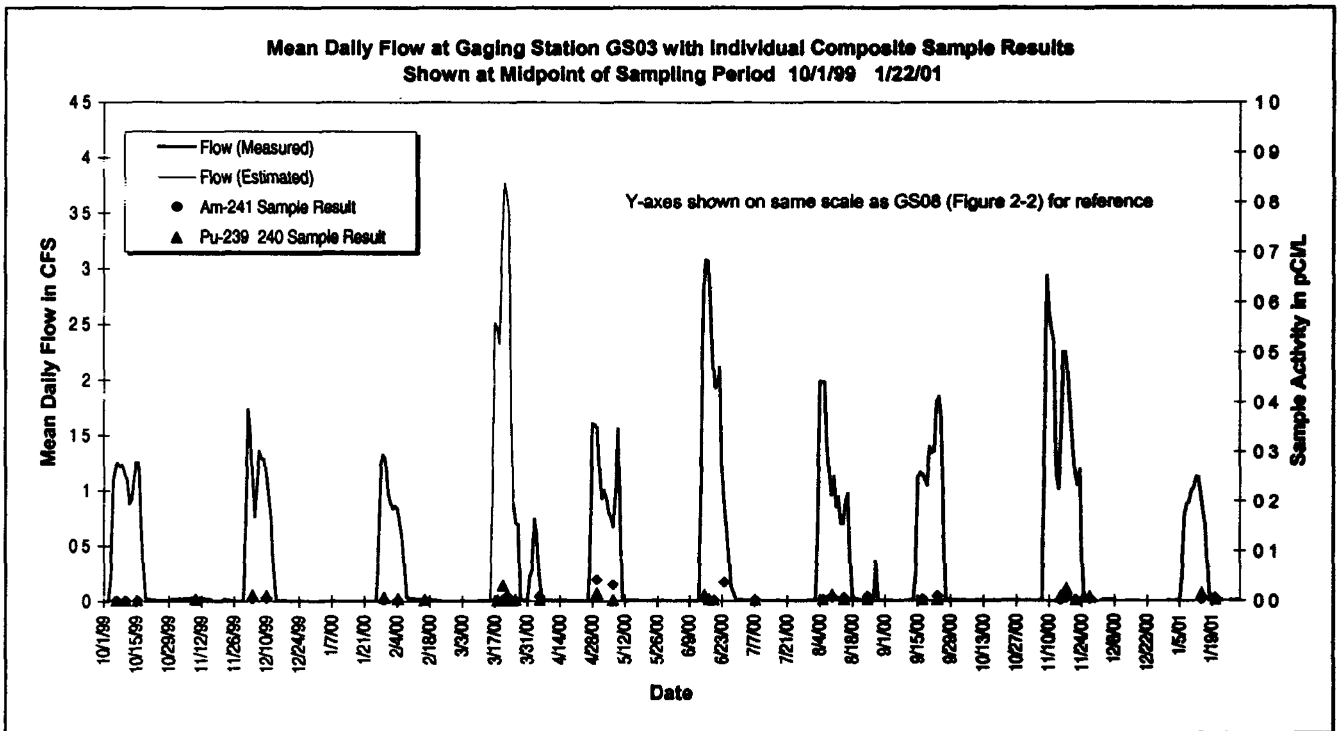


Figure 2 5 Gaging Station GS03 Hydrograph and Sample Results WY00

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3 ACTINIDE MIGRATION EVALUATION

The AME is a long-term technical study intended to provide an understanding of actinide migration and insights about the cause(s) and possible prevention of reportable radionuclide water-quality measurements This multi disciplinary study and the associated modeling initiative is key to understanding water-quality variation on the Site and may eventually describe the extent and conditions under which Pu and Am are transported in the Rocky Flats environs This section includes a discussion of AME progress and planned activities directly related to transport of actinides in surface water to provide background for Section 4 as related to this source investigation

The AME is investigating processes that influence the movement of actinides associated with soils and sediments into stormwater runoff Understanding these processes begins with a basic knowledge of the particle size distribution of the actinides in soil and sediment including the particle size and actinide enrichment processes that occur when soil or sediment is eroded and suspended in runoff Enrichment is the process whereby a percentage of specific particle sizes in the parent soil become enriched in the suspended load in the runoff Dr James Ranville (Colorado School of Mines) and Dr Peter Santschi (Texas A&M University) are investigating particle size enrichment processes for the AME Their work is integrated with stormwater monitoring and AME erosion/sediment transport modeling activities

Ranville et al (1998) found that the enrichment ratio for clay and silt sized particles (less than 10 microns) is about 1 65 The ratio of the average activity on suspended particles measured in the GS42 runoff (30 8 pCi/g) to the average bulk soil Pu activity in the GS42 drainage basin (15 5 pCi/g) calculates to an enrichment ratio of 1 99 In other words the activity per gram of the suspended solids is approximately twice that of the parent soil in the GS42 drainage basin Data are not yet available to make similar calculations for portions of the GS10 / GS08 drainage basin but the same mechanisms are suspected to account for actinides in the GS08 surface water Texas A&M University will conduct actinide particle size distribution experiments on GS27 soils in 2001 That study is expected to conclude investigation of colloidal actinides in Site surface water

The same phenomenon has been observed in the GS27 drainage basin which is tributary to GS08 by way of GS10 Particle enrichment is suspected to be the cause for high actinide concentrations in stormwater runoff from drainage basins with relatively low levels of soil contamination Factors that enhance the enrichment process include wetting and suspension time the total activity in the source soil or sediment and contact with colloid forming humic acids However it has been shown that contact with humic acids only increases actinide enrichment in the runoff by a fraction of a percent (Santschi et al 2000)

The enrichment process can also occur when the stream channel erodes However Site personnel do not have data to estimate the magnitude of the particle and actinide enrichment ratios for channel erosion The AME HEC-6T sediment transport models were modified in FY01 to simulate this channel erosion process The preliminary HEC-6T models for Walnut Creek indicate that channel erosion accounts for up to 50 percent of the sediment yield at GS08 for a storm with a one year return period (35mm rain in 11 5 hours one year event) The percentage of the sediment yield at GS08 attributed to channel erosion decreases with increasing storm size (i e increasing return period Table 3 1) Only about 5 percent of the estimated sediment yield at GS08 is attributed to channel erosion for the 100-year event

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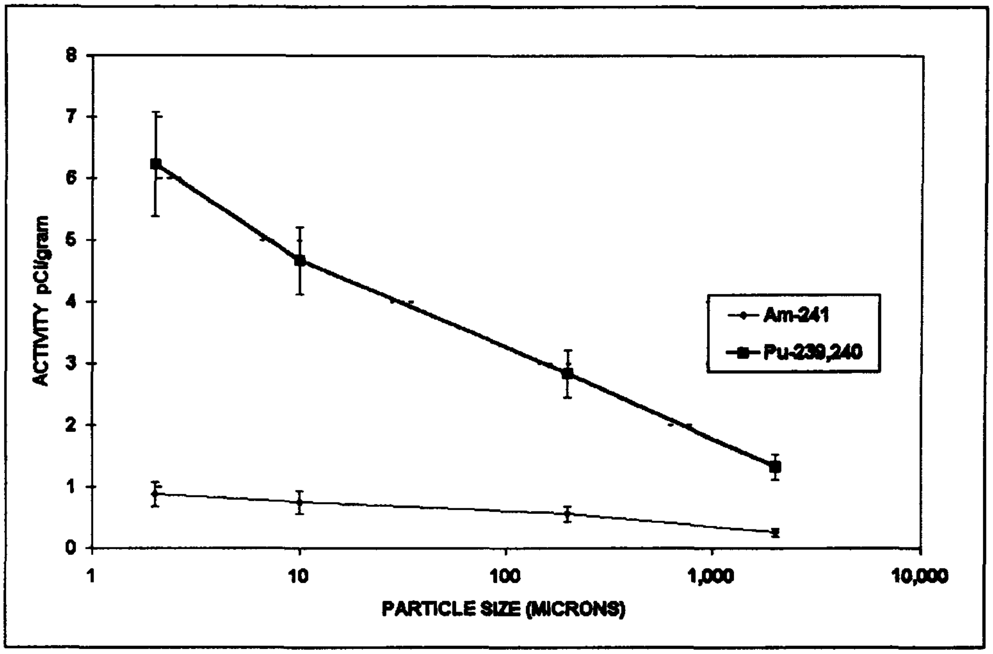

Figure 3 1 Particle Size Distribution of Pu 239 240 and Am 241 in RFETS Soil Location SSSE05198

At the Health Physics Society 2000 Conference in Denver (August 2000) Povetko and Higley presented a poster titled Study of Particles of Actinides in Soil Samples Using Nuclear Track Detectors Their work used a soil sample from near the 903 Pad at RFETS The investigators identified 990 discrete Pu-containing particles that included several large (greater than 2 microns) conglomerate particles containing Pu and Am. One such conglomerate with a particle size of about 500 microns contained 1 87 Bq (50 5pCi) or 94% of the total recorded alpha activity of 1 98 Bq in all 990 particles In other words the conglomerate contained 94% of the sample Pu while the other 989 particles contained the remaining 6%

The investigators conclusions support the hypothesis that the Pu in soils is not evenly distributed amongst particle sizes A majority of the total activity is associated with particular size fractions (and/or individual particles) of the total soil mass Therefore if these particles were preferentially suspended as total suspended solids (TSS) an enrichment of Pu activity in surface water would result Additionally the variable distribution of these high activity particles could result in variable measured surface water activities based on the probability that these particles may or may not be collected in the sample bottle

Santschi (2000) estimated the particle residence time in the Pond B 5 water column to be about one day This measurement was made during an algae bloom in the pond The algae bloom occurred partly due to nutrient loading from the Wastewater Treatment Plant (WWTP) At closure the WWTP will be removed and thus so will the nutrient load to Pond B 5 Therefore Dr Santschi will make similar particle residence time measurements in Ponds A 3 and C 2 this year to evaluate the potential affect that the WWTP effluent has on settling Samples for this work are scheduled to be collected in May 2001

Despite the rapid particle settling that occurs in Pond B 5 there is still activity in the water column downstream from the pond This prompted calculation of the average water residence time during the Pond B 5 discharge (8/3 – 8/17/00) Even though a small storm occurred during the discharge the average residence time in the pond was more than seven days which was ample time for settling of particulate actinides Therefore the activity in the Pond B 5 discharge is likely to have been adsorbed to colloidal material which is too small to

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settle in the pond or attached to re suspended sediment from the streambed immediately downstream from the pond

Table 3 1 Preliminary HEC-6T Model Estimated Channel Erosion Results for Walnut Creek

Event Depth (mm)	Reach	Channel Erosion in Model?	Estimated Sediment Yield (kg)	Estimated Sediment Concentration (mg/L)	Portion of Yield Attributed to Channel Erosion (%)	Portion of Yield Attributed to Hillslope Erosion (%)
100-Year 6-Hour 97 1 mm	South Walnut	Yes	16,831	183	5%	95%
		No	16,044	175		
	No Name	Yes	38,982	1,390	45%	55%
		No	21,509	767		
	Indiana Street	Yes	157,189	557	12%	88%
		No	138,413	490		
10-Year 6-Hour 62 3 mm	South Walnut	Yes	6,151	118	14%	86%
		No	5,289	101		
	No Name	Yes	5,757	660	22%	78%
		No	4,512	517		
	Indiana Street	Yes	63,519	478	31%	69%
		No	43,761	329		
17-May 95 74 9 mm	South Walnut	Yes	5,018	277	12%	88%
		No	4,412	243		
	No Name	Yes	11,345	748	80%	20%
		No	2,315	153		
	Indiana Street	Yes	48,996	469	20%	80%
		No	39,182	375		
2 Year 6-Hour 40 8 mm	South Walnut	Yes	736	27	20%	80%
		No	588	21		
	No Name	Yes	702	405	26%	74%
		No	517	298		
	Indiana Street	Yes	14,351	245	89%	11%
		No	1,514	26		
2 Year 2 Hour 31 5 mm	South Walnut	Yes	474	22	55%	45%
		No	213	10		
	No Name	Yes	572	680	54%	46%
		No	262	312		
	Indiana Street	Yes	18,211	426	97%	3%
		No	576	13		
1 Year 11 5-Hour 35 mm	South Walnut	Yes	22	5	50%	50%
		No	11	2		
	No Name	Yes	173	129	57%	43%
		No	75	56		
	Indiana Street	Yes	8,095	448	96%	4%
		No	342	19		

Note The South Walnut stream reach runs from the IA through GS08 The No Name reach ru the length of No Name Gulch (Figure 1 1) The Indiana Street stream reach covers all of Walnut Creek from the IA to Indiana Street ncluding No Name Gulch

4 DATA SUMMARY AND ANALYSIS

4 1 Verification and Validation of Elevated Analytical Results

All surface water isotopic data are either verified or validated based on criteria determined by Analytical Services Division (ASD) or at the special request of the customer Approximately 75% of all isotopic data are verified and the remaining 25% are validated Validation is typically determined randomly for each subcontracted laboratory based on the specific analytical suites This random validation selection may or may

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not routinely include POE or POC locations However when reportable values are observed all analytical results used in the calculations receive formal validation

For samples collected at GS08 between 5/2/00 – 11/20/00 all isotopic data not randomly selected for validation were specifically submitted for validation at the request of Site personnel All isotopic data package validation was performed by a subcontractor to ASD and all packages in the date range identified were considered valid

In reviewing the data for this evaluation particularly the composite sample dated 8/11/00 several topics for investigation were identified Specifically analytical problems were encountered during analysis and with blank correction of data The analyzing laboratory required several reruns of the 8/11/00 sample in order to provide a result that met the Statement of Work criteria for isotopic analysis The case narrative for this sample indicated that duplicate sample equivalency and poor spectra resolution were the causes for reanalysis the first two times On the third and last analysis less than usual sample volume was remaining for analysis (0 8 liters vs 1 0 liters required by lab procedure) The slightly reduced sample volume was most likely reflected in a somewhat higher error term. No other anomalies were reported in the case narrative or identified in the review of the data package

The subcontracted lab that performed the 8/11/00 analysis had only recently begun providing blank corrected water analyses for the Site The lab has had some difficulty with the blank correction calculations using a Winsorized mean of the blank population and after direction from the Site the lab provided corrected analytical data No significant changes to either the reported result or the error term were seen in the corrected data

The Pu/Am ratio in the 8/11/00 sample is not typical of current or historical data at the GS08 location The review of the data package did not provide any suggestion of other analytical problems that could have contributed to the unusual ratio However there is no conspicuous reason to eliminate this result from the overall data set

The review of the remaining data included in the 5/2/00 – 11/2/00 period indicated no unusual analytical problems or concerns As stated previously all data for samples collected in this period were considered valid

4 2 Evaluation of Numeric Precision for RFCA Reporting

This reportable event has refocused the attention on the numeric precision associated with RFCA monitoring results The GS08 event includes calculated 30-day moving averages for Pu that range from 0 151 to 0 154 pCi/L The difference between this calculated value and the standard is well within the measurement error of the radiochemical analysis methods Although laboratories report analytical results to 3 decimal places (to 0 001 pCi/L) confidence in the third decimal place for the calculated 30-day averages that triggered the reporting requirements may be very low

The concept of significant figures has been developed to formally designate the reliability of a numerical value The significant figures of a number are those that can be used with confidence They correspond to the certain digits plus one estimated digit It is conventional to set the estimated digit to zero or to one-half of the smallest scale division on the measurement device For example staff gages that measure water depth on Site flow control structures (flumes weirs etc) have markings for each 0 01 feet Therefore flow meters in the field are set to the nearest 0 005 feet

Similarly flow measurement at Site surface water monitoring locations is generally accurate to 2 significant figures[5] Overall flow measurement at these locations is considered accurate to ±5 15% For example GS03 can accurately measure 1 2 cfs but not necessarily 1 23 cfs The 1 cfs is measured with certainty and the 0 2 cfs represents the estimated digit Similarly the much smaller flume at a location like SW091 can accurately measure 0 23 cfs with 0 2 cfs being measured with certainty and the 0 03 cfs being the estimated quantity

[5] Flow measurement devices are selected and sized to accurately measure the expected range of flows for particular locations For example the flumes at GS03 are sized to measure flows up to approximately 45 cfs Similarly the flume at SW091 is sized to measure much smaller expected flows up to approximately 2 cfs

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Calculation of RFCA 30-day volume weighted average values requires measurement of both flow converted to volume and concentration as radionuclide activity Analytical results from Kaiser Hill s contracted laboratories are generally reported to at least 3 significant figures For example analytical results are reported as 1 19 or 0 119 pCi/L Therefore since the 30-day average calculation uses activities reported to 3 significant figures and flows measured to 2 significant figures 30-day average values can be estimated with confidence to 2 significant figures

While water quality standards do not go so far as to specify how many significant figures should be reported standards are generally based on scientific and engineering principles including standard data handling methods Therefore it must be assumed that a numeric water-quality standard is sufficient to establish the level of accuracy necessary to demonstrate compliance In the management of data any digit that is necessary to define the specific value or quantity is significant For example a standard published as 6 5 standard units (SU) for pH establishes that observations must be reported with two significant digits Measurements taken for comparison to a pH standard must be taken with a sensitivity to at least 0 1 SUs

This review demonstrates that there is a lack of confidence in the third significant figure for reported RFCA 30 day average values In consideration of standard significant figure conventions DOE intends to report all future 30-day volume weighted average values rounded to 2 significant figures No rounding will occur with the measured input numbers prior to calculation of the 30-day averages Only the final calculated value will be rounded For example a calculated value of 0 124 pCi/L would be rounded to 0 12 pCi/L Similarly a value of 0 246 pCi/L would be rounded to 0 25 pCi/L

4 3 Pond B 5 Discharge Operations

Pond operations practices during WY00 conformed to the guidelines established during the 1998 Water Working Group Technical Team forum for Pond B 5 direct discharge to South Walnut Creek Under the established pond operations protocol pre-discharge sampling is initiated when a terminal pond reaches 35% of capacity The Colorado Department of Public Health and Environment (CDPHE) laboratories analyze pre discharge samples on a two-week turnaround priority After analyses are completed analytical results are reviewed to determine if they meet downstream water quality standards prior to starting the discharge Typically pond levels approach ~50% of capacity at the time discharge is initiated and the discharge typically takes ~12 days to lower the pond level to 10% of capacity

Figure 4 1 summarizes inflows to Pond B 5 from GS10 and outflows from B 5 measured at GS08 (see Figure 2 3 map) Significant operational events are indicated on the figure The 8/11/00 sample from GS08 (0 864 pCi/L Pu) was collected as the last of three composite samples collected during the 8/3 through 8/17 batch discharge The prior batch discharge ended on 6/26/00 at 10 15 Between the end of the 6/00 batch discharge and the predischarge sample collected on 7/18 at 10 15 approximately 5 7 Mgals entered Pond B 5 from GS10 During the same period approximately 4 2 Mgals entered Pond B 5 from the WWTP Several large runoff events occurred during this period with the largest on 7/17 7/18/00 (estimated peak of 69 cfs at GS10) Following this event Pond B 5 had risen to 54% of capacity initiating collection of the 7/18/00 pre-discharge sample The predischarge sample had the following results

- undetect for TSS (<10 mg/L)
- 0 061 pCi/L Pu and
- 0 005 pCi/L Am.

Between the predischarge sample and the start of the 8/00 B 5 discharge (8/3 8 56) there were no runoff events measured at GS10 During this period the total volume measured at GS10 was approximately 0 58 Mgals For the same period approximately 3 5 Mgals entered B 5 from the WWTP By 8/3/00 Pond B 5 levels had risen to 67% of capacity when predischarge sample analysis results were finally received Direct discharge was initiated with a targeted maximum discharge rate of 1 400 gallons per minute Discharge rates were periodically adjusted to meet the recommended 1 foot per day pond level drawdown rate as established by the pond operations protocol

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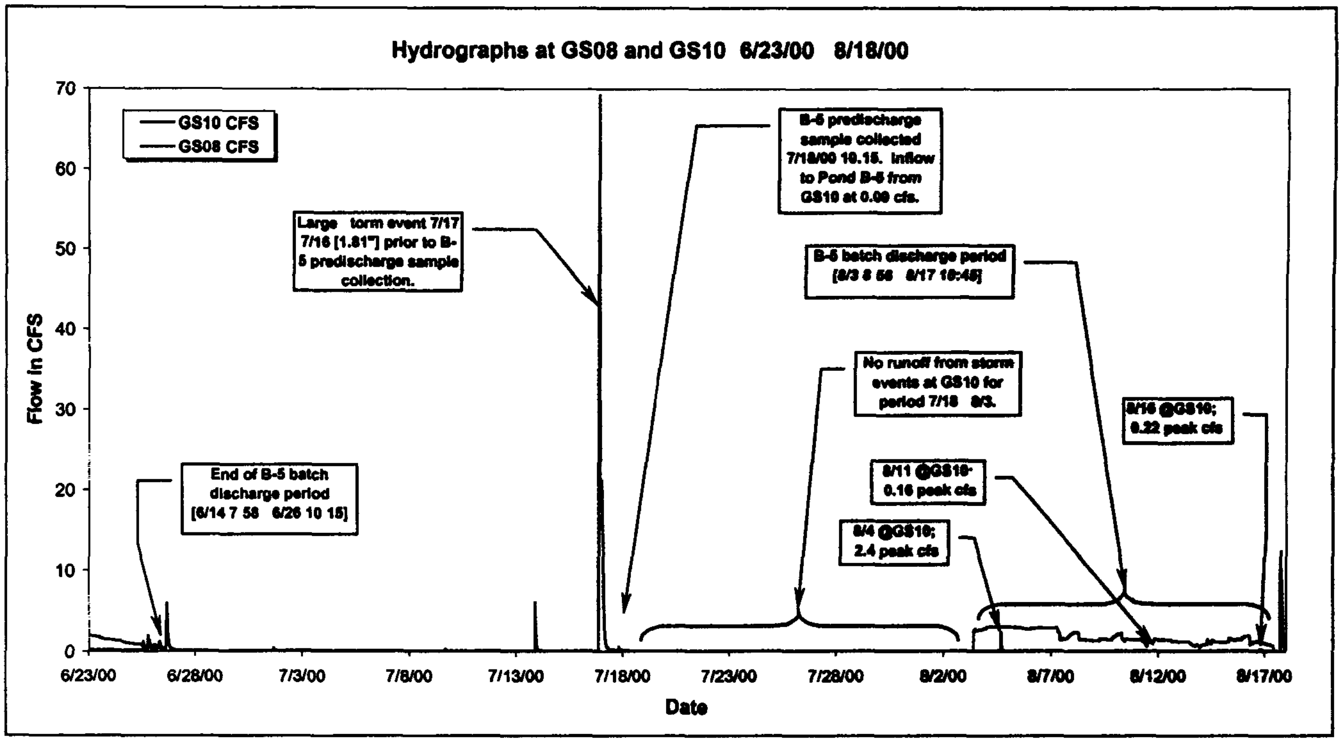

Figure 4 1 Gaging Station GS10 and Pond B 5 (GS08) Hydrographs Showing Operation Events

Figure 4 2 shows the hydrograph and sampling detail for the three composite samples collected at GS08 during the 8/00 batch discharge During this period approximately 0 45 Mgals were measured at GS10 with only three small runoff events (peak 2 4 cfs on 8/4 peak 0 16 cfs on 8/11 peak 0 22 cfs on 8/16) However these storm events failed to meet the criteria specified in the Pond Operations Plan that would require a pause in the discharge event According to the Pond Operations Plan a terminal pond discharge must be paused if a storm event exceeds 0 50 inches of precipitation to allow more settling time for suspended solids For the same period approximately 2 5 Mgals entered Pond B 5 from the WWTP The direct discharge ended on 8/17/00 with a final discharge rate of 400 gallons per minute and the B 5 level at 11% of capacity

In summary predischarge sampling was initiated as required by the Pond Operations Protocol and the discharge was initiated based on acceptable analytical results Discharge rates for the entire 8/00 discharge event conformed to the 1995 recommendations by the Office of the Colorado State Engineer and closely approximated the average rates used routinely for all Site terminal pond discharges during the previous 10-year period Additionally the Pond B 5 operations were well timed given the weather pattern for the period The predischarge sample was collected soon after the largest runoff event entering Pond B 5 which would be expected to provide a worst case condition for B 5 water quality Further for the period between the predischarge sample and the initiation of the 8/00 discharge very little runoff entered Pond B 5 as measured by GS10 In addition the 8/00 discharge was terminated 7 hours before a large runoff event on 8/17 (peak 12 3 cfs at 18 00)

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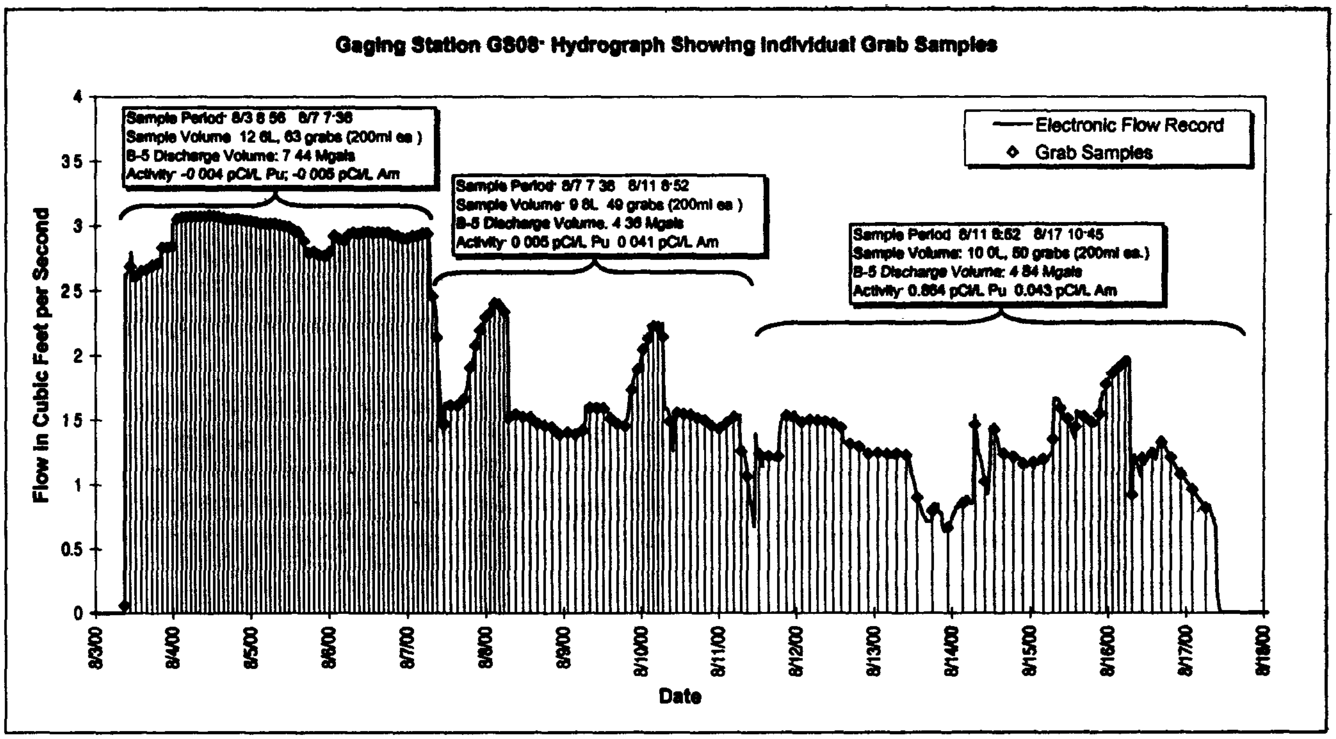

Figure 4 2 Pond B-5 Discharge (GS08) Sampling Hydrograph

4 4 Environmental Monitoring Data

The following data evaluation includes all surface water data available as of 3/26/01 [6] Monitoring data were extracted from the Site Soil Water Database (SWD) or taken from hardcopy analysis reports for the locations of interest The following list describes the environmental data compilation process

- Individual sample result values are calculated as arithmetic averages of real and field duplicate results when both results are from the same sampling event
- When available laboratory re runs are averaged with initial runs for the same sampling event
- Laboratory duplicate and replicate QC results are not used
- When negative values for actinide measurement are returned from the laboratories due to blank correction 0 0 pCi/L (0 0 pCi/g for sediment) is used in the calculations
- When TSS values are undetect half the detection limit is used in calculations unless indicated otherwise
- Only total radionuclide measurements are used and

  Data that did not pass validation (rejected data) are not used

[6] Surface water data for B 5 discharges includes co-located monitoring locations GS08 B5EFF and B5DISC Data from location SW025 (50 feet downstream) are also included with GS08 Surface water data for POE GS10 includes co-located monitoring locations SW023 SW67593 and SW68893 Evaluations are performed using various data subsets These subsets are defined in the text or in notes below each figure/table

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4 4 1 Surface Water and Sediment Data

Activity in surface water samples collected at GS08[7] from 10/1/96 to the present[8] (RFCA monitoring) show a range of 0 0 to 0 864 pCi/L Pu (Figure 4 3) and 0 0 to 0 275 pCi/L Am (Figure 4-4) In summary 4% of the Pu results and 2% of the Am results were greater than 0 15 pCi/L during RFCA monitoring The histograms show that samples with activities greater than 0 15 pCi/L are rarely collected The histograms also show the extreme variation of the few higher results when compared to typical activities Although the few elevated samples have resulted in reportable 30-day averages annual volume weighted average[9] activities for the period of RFCA monitoring are all below the Pu and Am standards (Figure 4 5)

Hunt et al (1981) define an *outlier* to be an observation that does not conform to the pattern established by other observations Outliers may arise from data-coding errors analysis errors instrument breakdowns calibration problems cross-contamination sample preparation errors etc In addition outliers may be manifestations of a greater amount of spatial or temporal inherent variability than expected for the constituent

Using the histograms in Figure 4 3 and Figure 4-4 and the accompanying non parametric quantiles it can be seen that the elevated sample results at GS08 appear to be outliers that are inconsistent with the other observations Other data analyses discussed below also indicate that these results do not conform to expected patterns

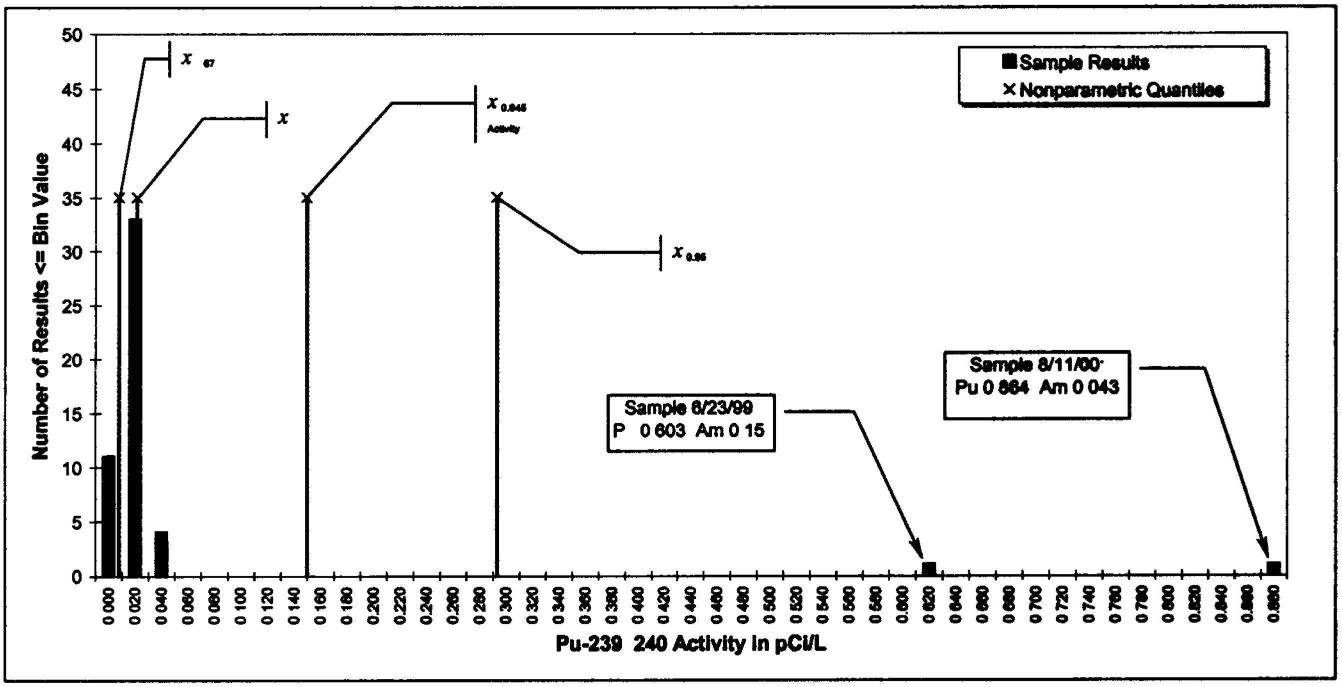

Figure 4 3 RFCA Sample Result Distribution at GS08 for Pu 239,240

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[7] In this section GS08 refers to co-located monitoring locations GS08 B5EFF B5DISC and SW025

[8] Includes data through the 1/01 batch discharge from B 5 Analysis of the 3/01 batch discharge samples was not complete as of 3/26/01

[9] The annual volume weighted average activity is calculated using the activities for each composite sample and the associated stream discharge volume to calculate a pCi load for each sampling period The total loads for the year are then divided by the total annual stream discharge volume to obtain the average in pCi/L

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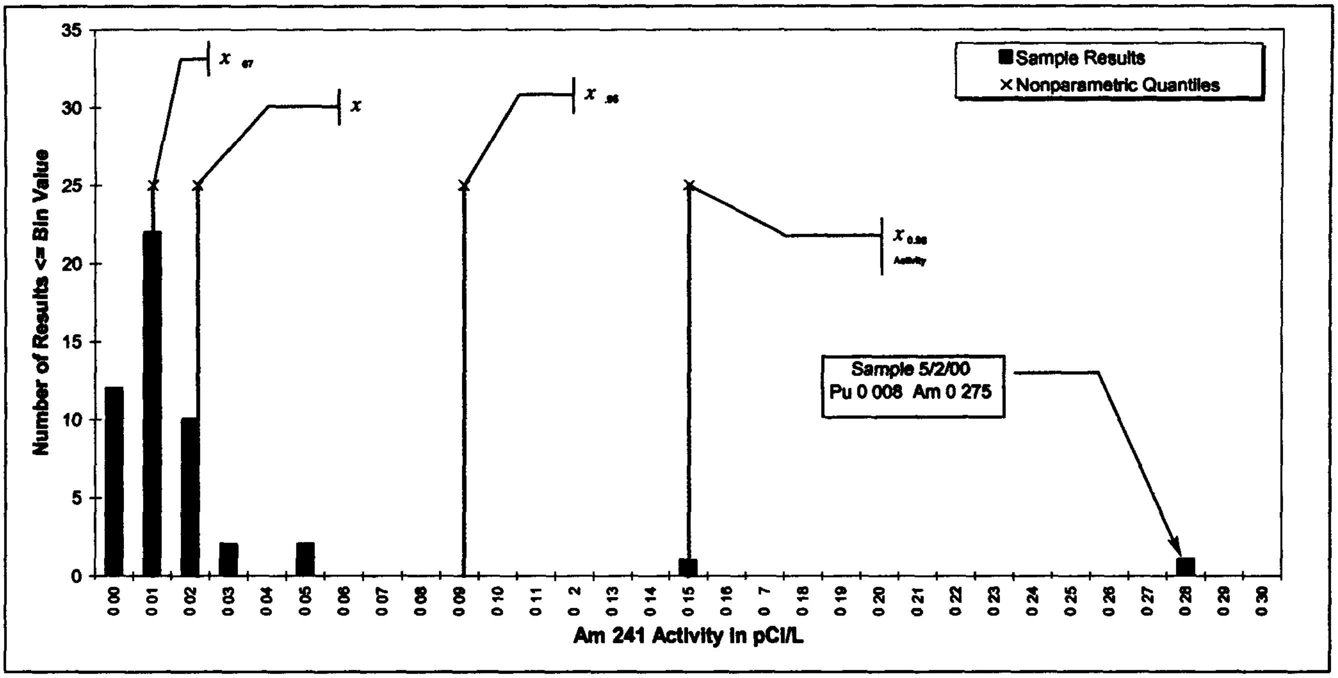


Figure 4-4 RFCA Sample Result Distribution at GS08 for Am 241

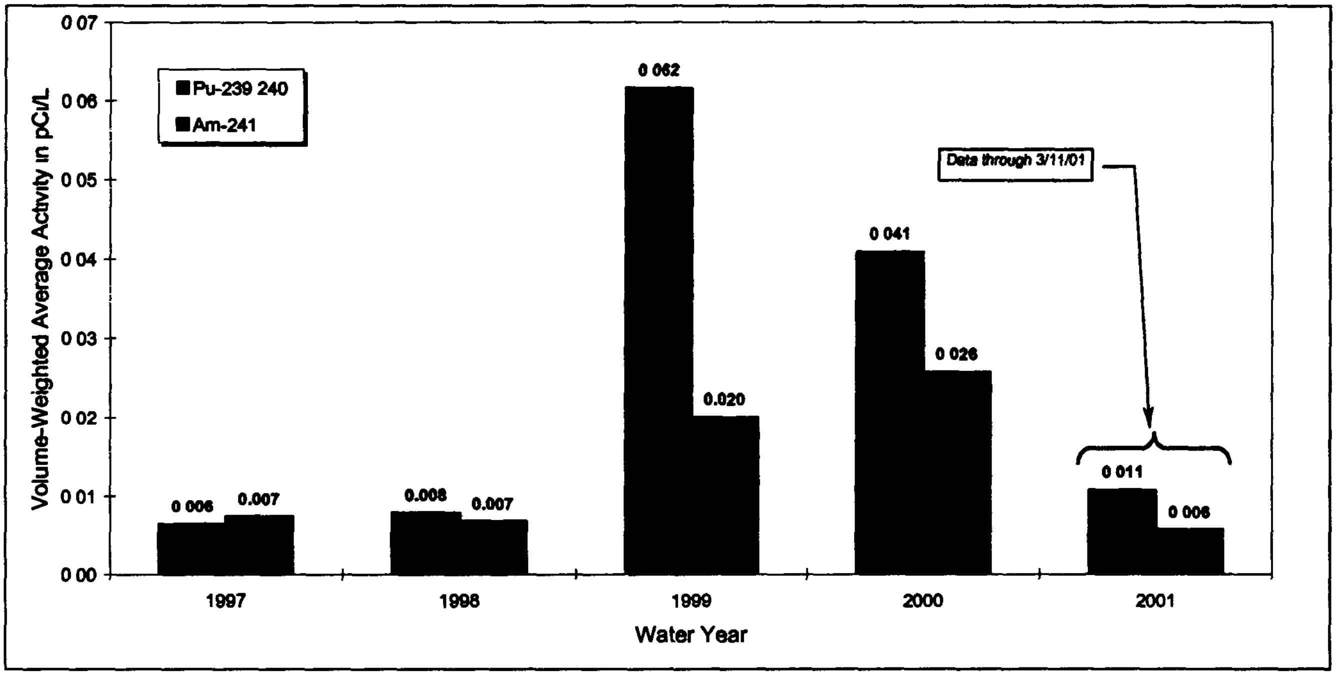
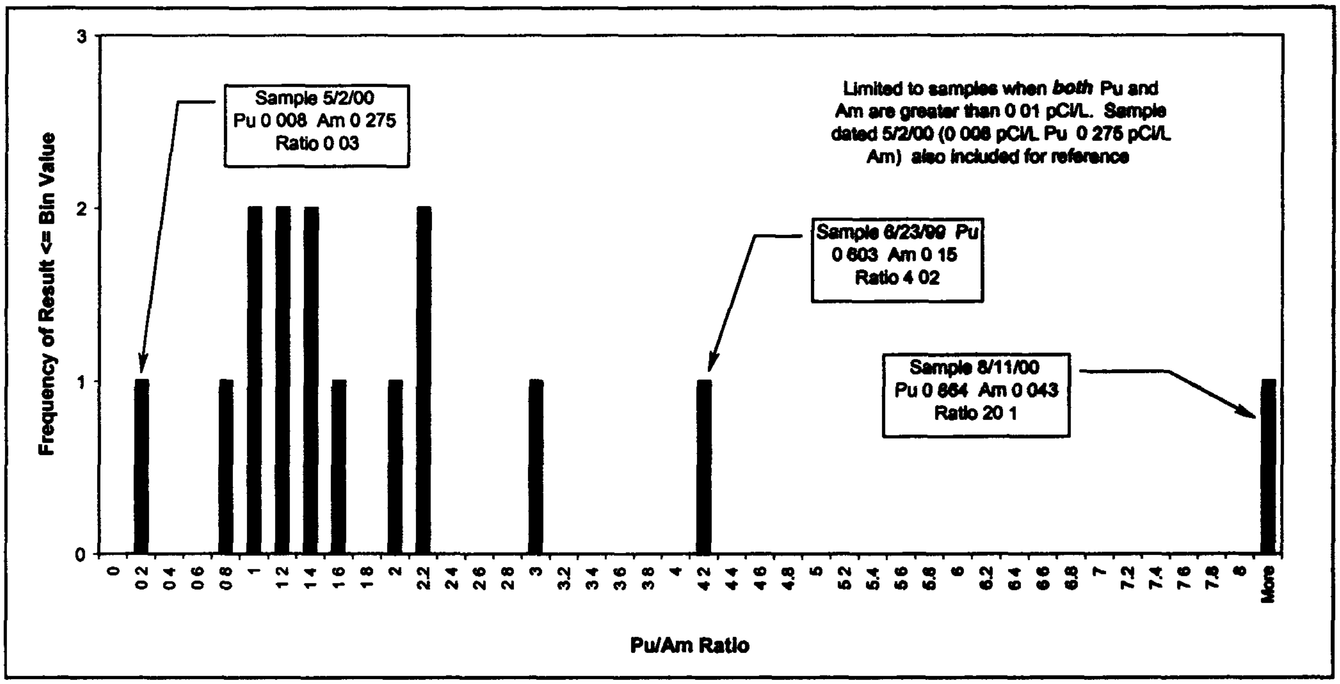


Figure 4 5 Annual Average Volume-Weighted Activities for RFCA Monitoring at GS08

20

For the data subset shown in Figure 4-6 surface water Pu/Am ratios at GS08 range from 0 03 to 20 1 For the three samples with Pu or Am activities greater than 0 15 pCi/l indicated in the figure two samples show ratios at both ends of the distribution Using the data subset from Figure 4-6 and also excluding the samples with results greater than 0 15 pCi/L the arithmetic average ratio is calculated as 1 49 (Figure 4-7) In contrast ratios for samples collected at GS10[10] show a narrower range of 0 15 to 3 9 (Figure 4-8) with an arithmetic average of 1 09 (Figure 4 9) In summary the GS08 samples with activities greater than 0 15 pCi/L differ significantly from the expected pattern

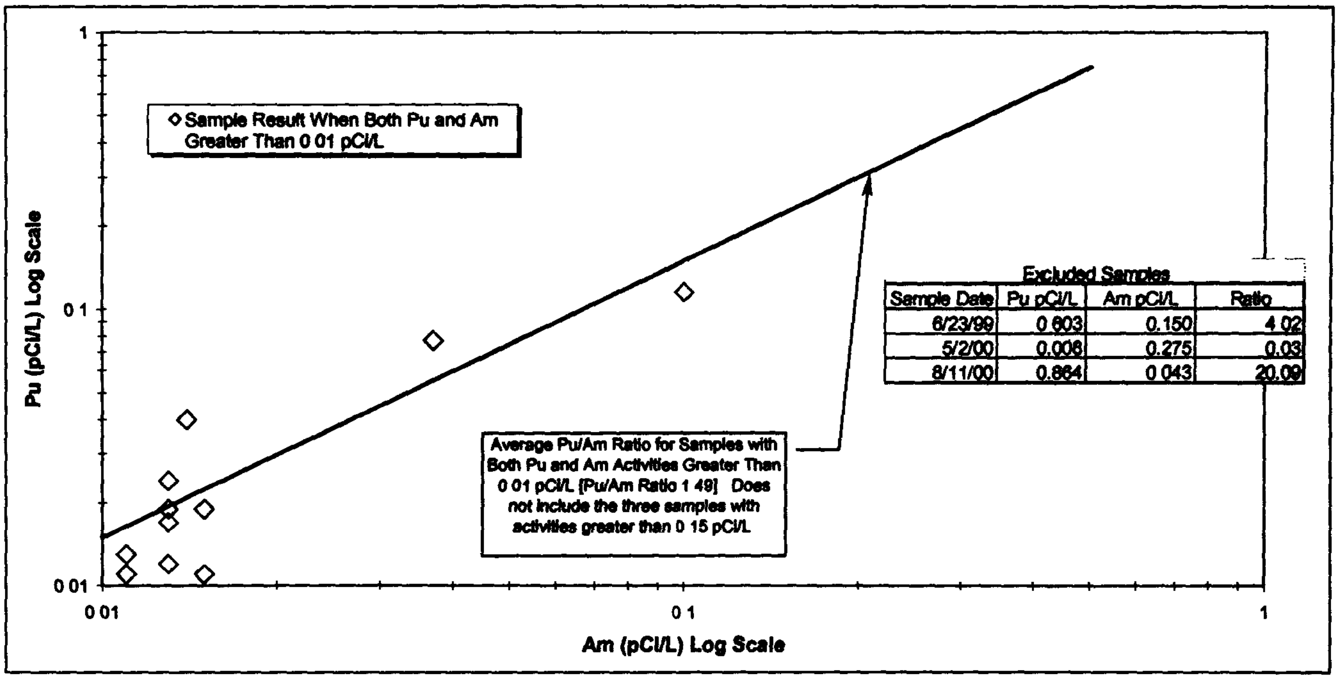


Note Included ratios are limited to samples where *both* Pu and Am are greater than 0 01 pCi/L to exclude ratios for samples with very low activities and high relati e error terms

Figure 4 6 Sample Result Distribution at GS08 for Pu/Am Ratios (Data Subset)

[10] The drainage area tributary to GS10 is the likely source of the majority of the actinides reaching Pond B 5

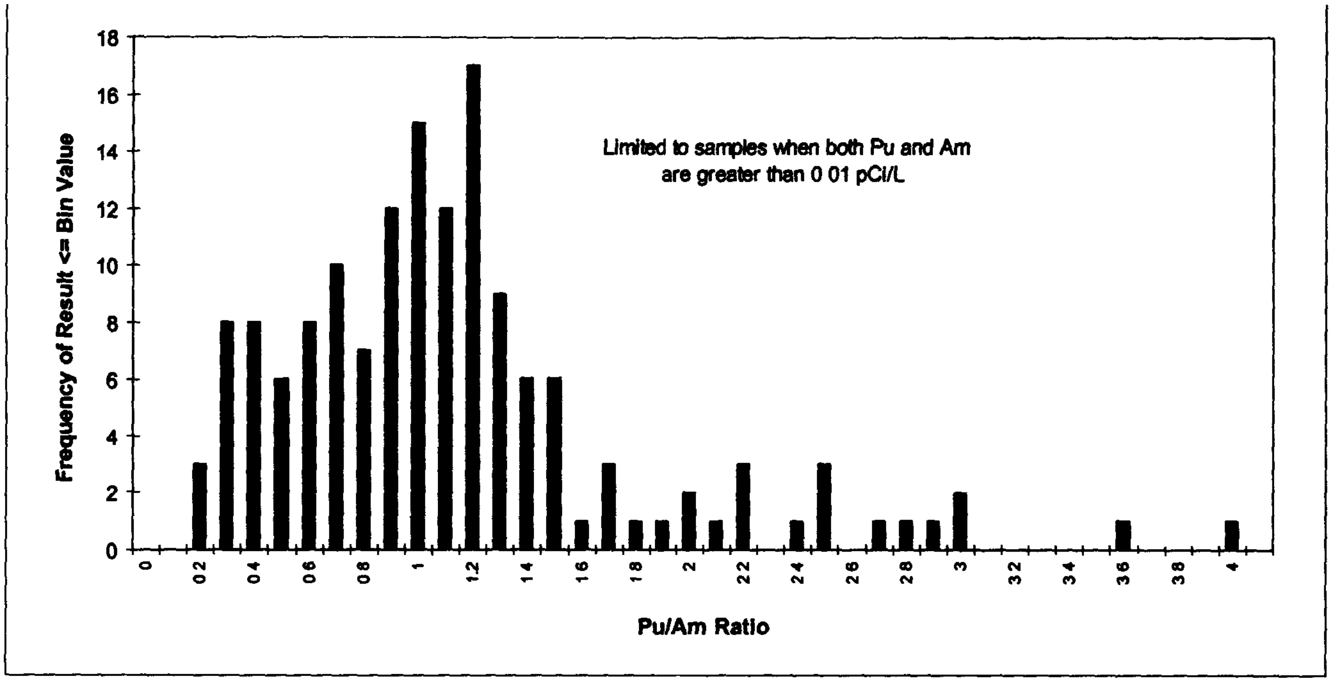
21



Sample Date	Pu pCi/L	Am pCi/L	Ratio
6/23/99	0 603	0.150	4 02
5/2/00	0.008	0.275	0.03
8/11/00	0.864	0 043	20.09

Note Included ratios are limited to samples where *both* Pu and Am are greater than 0 01 pCi/L to exclude ratios for samples with ery low activities and high relati e error terms The three samples with activities greater than 0 15 pCi/L are also excluded

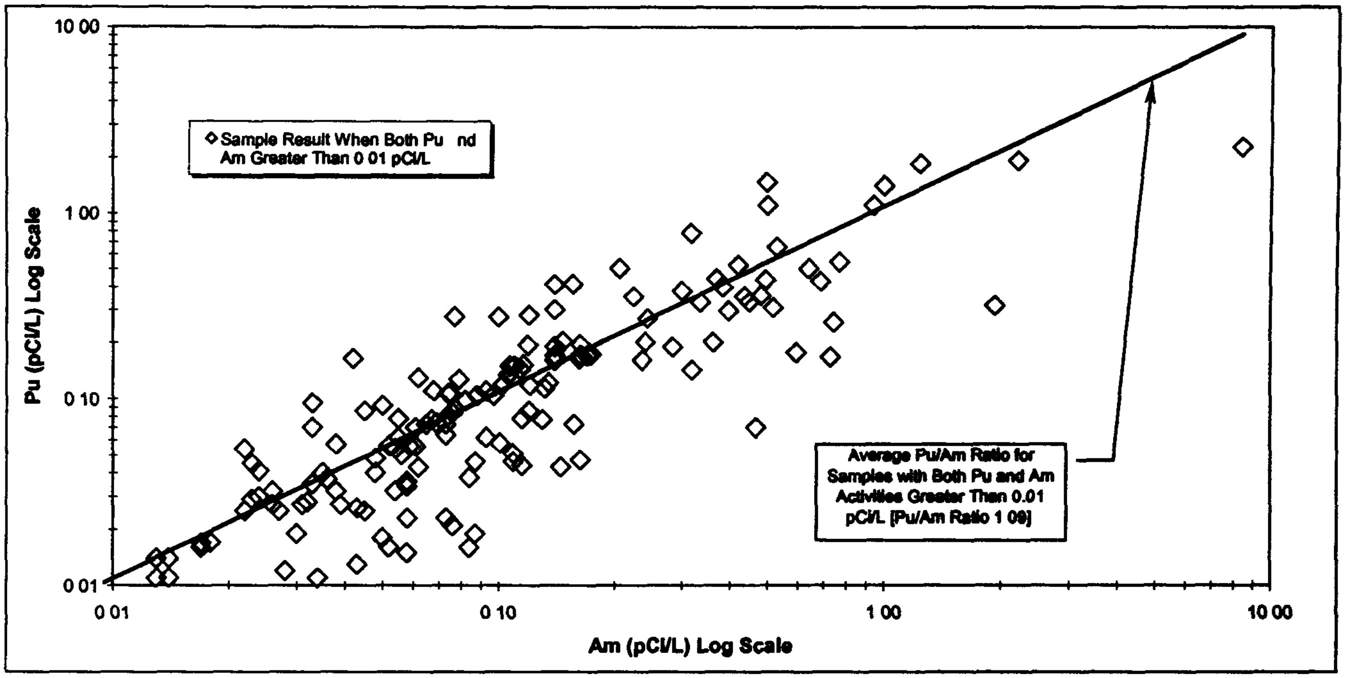
Figure 4 7 Relationship Between Pu and Am for Samples from GS08 (Data Subset)



Note Included ratios are limited to samples where *both* Pu and Am are greater than 0 01 pCi/L to exclude ratios for samples with ery low activities and high relative error terms

Figure 4 8 Sample Result Distribution at GS10 for Pu/Am Ratios (Data Subset)

22



Note Included ratios are limited to samples where *both* Pu and Am are greater than 0 01 pCi/L to exclude ratios for samples with very low activities and high relative error terms

Figure 4 9 Relationship Between Pu and Am for Samples from GS10 (Data Subset)

Research indicates that Pu and Am form strong associations with particulate matter [11] If contaminated particles are transported in surface water then the observed plutonium levels could be correlated with the amount of TSS During higher intensity precipitation events with increased raindrop impact greater quantities of solids are transported in overland flow Similarly higher flow rates in ditches and creeks generally result in increased TSS values due to higher flow velocity and turbulence which causes sediment re suspension

Research (Santchi 2000) also supports the hypothesis that the Pu and Am in soils is not evenly distributed amongst particle sizes (Section 3) A majority of the total activity is associated with particular size fractions of the total soil mass As particles from this parent material are suspended as TSS in surface water runoff it is reasonable to assume that this uneven actinide distribution of hot particles would also be represented in the TSS Assuming that the existence of these relatively hot particles is infrequent, the probability that one or more of these particles would be collected in a sample could be very low Collecting hot particles could result in the high variability of activity observed for Site surface water samples

Figure 4 10 shows a strong correlation between Pu and TSS for samples collected at GS10 Similarly for the GS08 data subset shown in Figure 4 11 measured Pu increases slightly with increasing TSS concentration The 8/11/00 sample collected at GS08 (Pu 0 864 pCi/L TSS 29 0 mg/L) deviates significantly from this trend indicating that the sample contained TSS with relatively high activity or particle(s) with relatively high activity The two samples collected immediately prior to the 8/11 sample showed little Pu activity on the suspended solids (-0 004 pCi/L for <5 mg/L TSS and 0 005 pCi/L for 14 mg/L TSS) Additionally three runoff events entered B 5 during the discharge period (Section 4 3) but were small and would have been unlikely to provide loads resulting in significant changes in water quality In summary the 8/11 sample collected at GS08 does not conform with the expected Pu TSS patterns

[11] The majority of Pu and Am transport is associated with particulate matter Recent AME results provide additional confidence in this conclusion (Santchi 2000) See Section 3

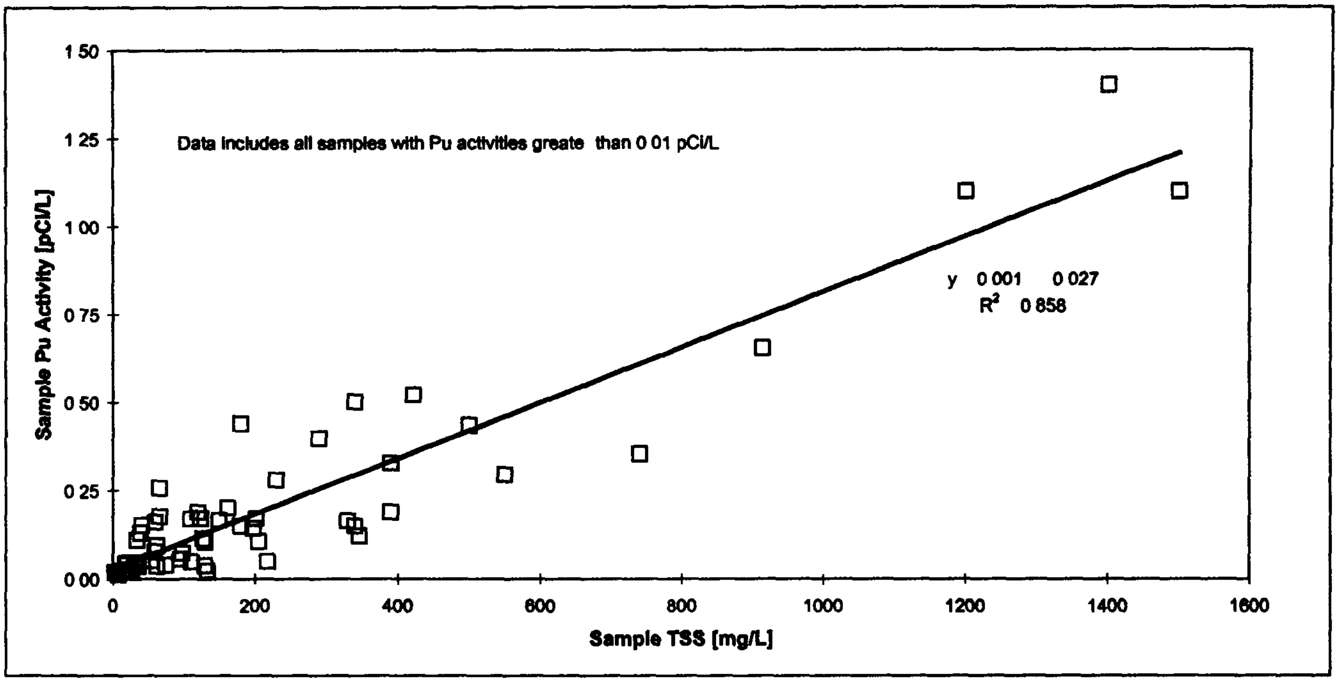


Figure 4 10 Relationship Between Pu and TSS for Samples from GS10 (Data Subset)

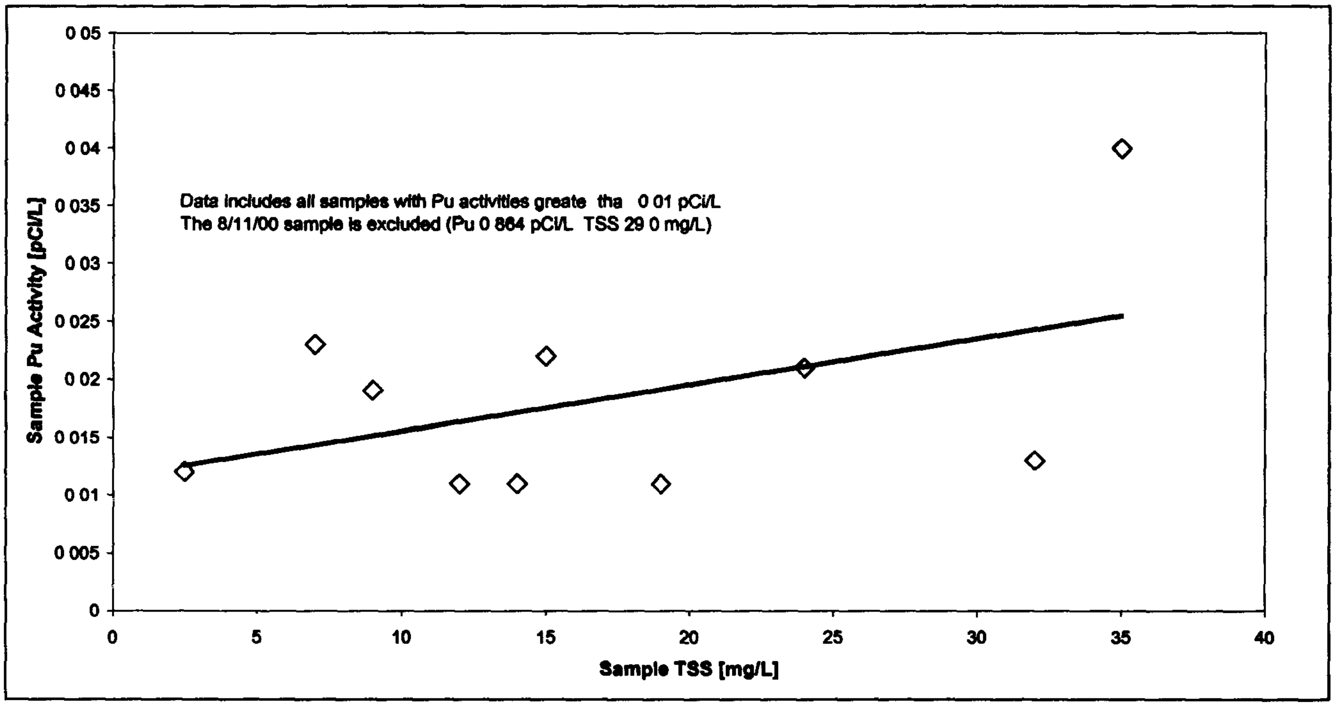


Figure 4 11 Relationship Between Pu and TSS for Samples from GS08 (Data Subset)

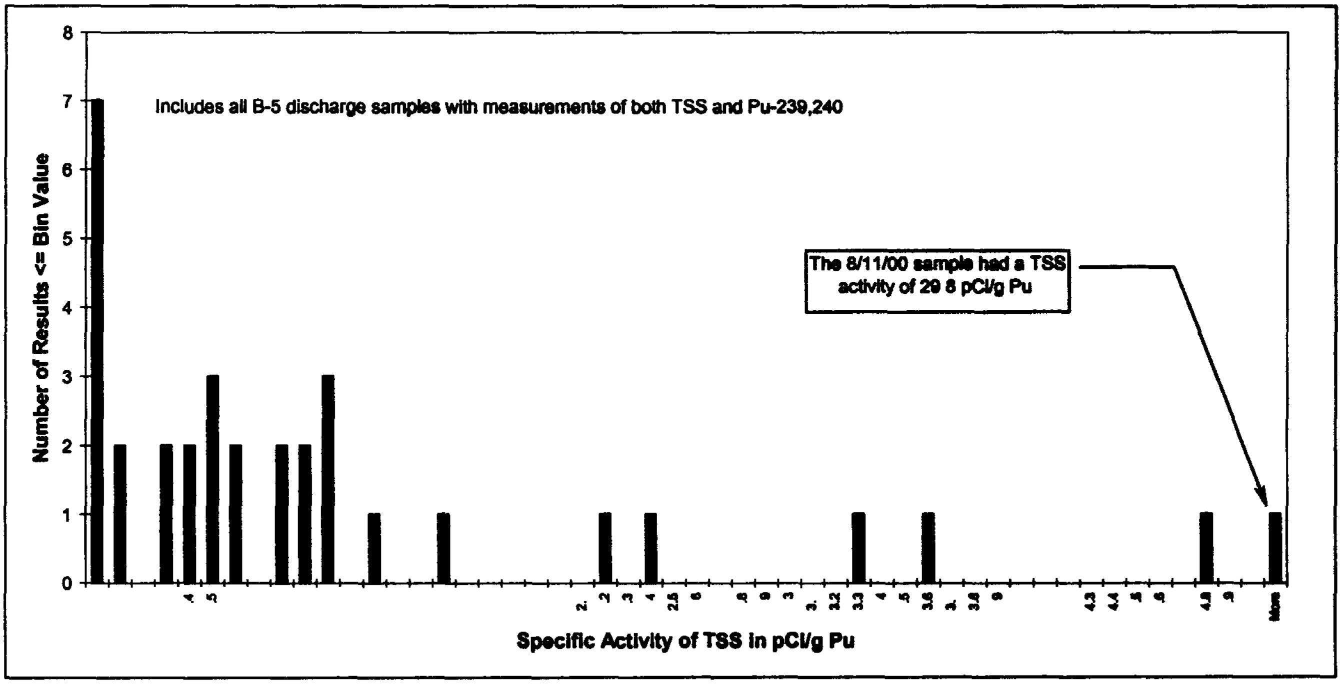
24

The Pu activity of TSS (in pCi/g Pu) can be calculated by dividing the sample activity (pCi/L Pu) by the TSS concentration (mg/L) For GS08 samples the TSS activity ranged from 0 0 to 29 8 pCi/g Pu (Figure 4-12) with an arithmetic average of 0 9 pCi/g Pu (excluding the 8/11 sample) The 8/11 sample from GS08 had a TSS Pu activity of 29 8 pCi/g In contrast TSS activities for samples collected at GS10 show a narrower range of 0 58 to 7 2 (Figure 4 13) with an arithmetic average of 2 0 pCi/g Pu In summary the 8/11/00 sample from GS08 with 29 8 pCi/g Pu deviates significantly from the expected pattern

In summary the following conclusions are made about the 8/11/00 GS08 sample

- The Pu/Am ratio for the 8/11 sample was 20 1 five times greater than the next highest ratio and more than thirteen times greater than the average of 1 49 for the data subset
- The activity of the 8/11 sample (0 864 pCi/L Pu) is nearly forty times greater than the expected activity based on the TSS concentration (29 0 mg/L)
- The activity of the TSS for the 8/11 sample was 29 8 pCi/g Pu more than six times greater than the next highest TSS activity and more than thirty times greater than the average of 0 9 pCi/g Pu for the data subset.

Although one might assume that this indicates the possibility of an invalid result, this result may be a manifestation of a greater amount of spatial or temporal inherent variability than expected for Pu in surface water The existence of hot particles particle aggregation enrichment mechanisms or other physiochemical / biochemical mechanisms may result in the collection of samples that do not follow expected patterns [12] The multi-disciplinary studies associated with the AME will provide a better understanding water-quality variation on the Site and may eventually describe the extent and conditions under which Pu and Am move in the Rocky Flats environs

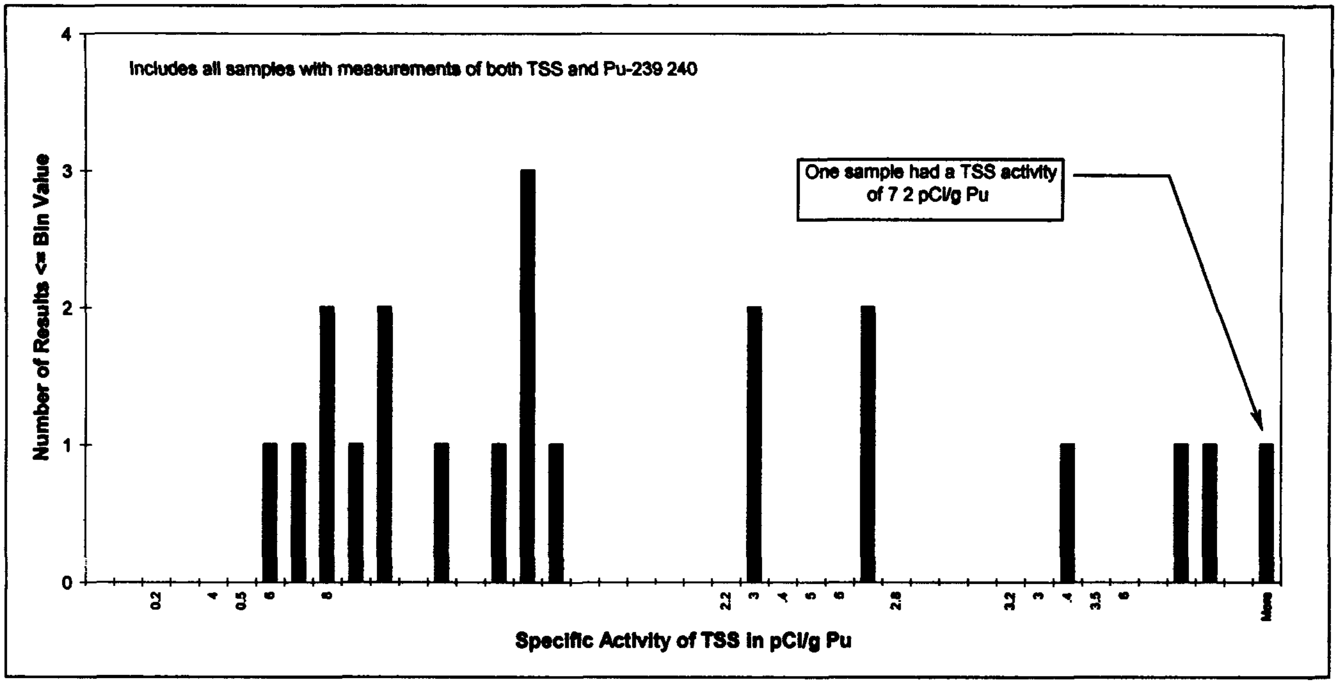


Note Data s limited to co ti uous flow paced samples collected during the period of RFCA monitoring

Figure 4 12 Distribution of Pu Activity of TSS for Samples Collected at GS08

[12] Even if the activity of the 8/11/00 sample was the result of a hot particle the ratio would still be expected to be in the 5 7 range characteristic of the Site weapons grade material This does not necessarily imply that the Pu measurement was faulty Instead it is possible that only the Am measurement is faulty resulting in the anomalous ratio for this sample

25



Note Data limited to contin ous flow paced samples collected during the period of RFCA mon toring

Figure 4 13 Distribution of Pu Activity of TSS for Samples Collected at GS10

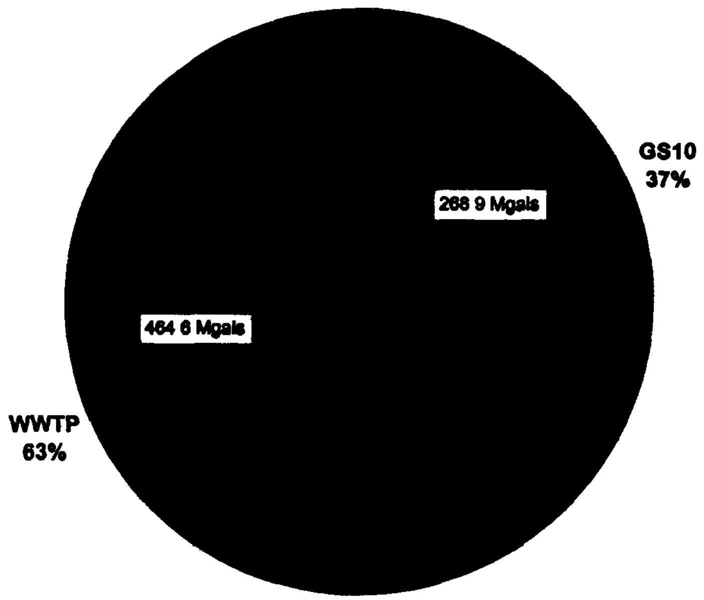
Regardless of the specifics of the 8/11/00 GS08 sample water-quality measurements from the upstream POE GS10 indicate the majority of the actinides reaching Pond B 5 originate in drainage areas tributary to GS10 (Figure 1 1) The monitored sources of water that enter B 5 include GS10 and the WWTP (Figure 2 3) A significant area downstream of GS10 surrounding the B Series Ponds (96 acres) is also tributary to B 5 However under most conditions it is likely that this area contributes only a small amount of the total runoff volume to B 5 This area is predominantly pervious open grassland Performing a water balance for B 5 during the period from the end of the 6/00 discharge through the end of the 8/00 discharge shows a loss of 2 0% [13] Additionally for the period from the predischarge sample (7/18/00) to the end of the 8/00 batch discharge 0 31 inches of precipitation were measured at the Site with 0 13 inches from the largest single storm During this same period monitoring locations with drainage characteristics similar to the area downstream of GS10 showed no runoff [14] Therefore the only significant sources of surface water inflow to the 8/00 B 5 batch discharge were likely GS10 and the WWTP

On average the WWTP contributes 63% of the water to B 5 while GS10 contributes the remaining 37% (Figure 4 14) However measurements of Pu and Am activities at GS10 are generally 10 100 times higher than at the WWTP (Figure 4 15 and Figure 4 16) During the period of RFCA monitoring 30-day moving averages at GS10 have frequently exceeded the action level of 0 15 pCi/L (Figure 4 17) suggesting that the GS10 sub-drainage is a significant contributor of actinide load to Pond B 5

[13] The balance used inflows from the WWTP and GS10 outflows from B 5 and B 5 pool volumes The 2% calculated loss is within the flow measurement error

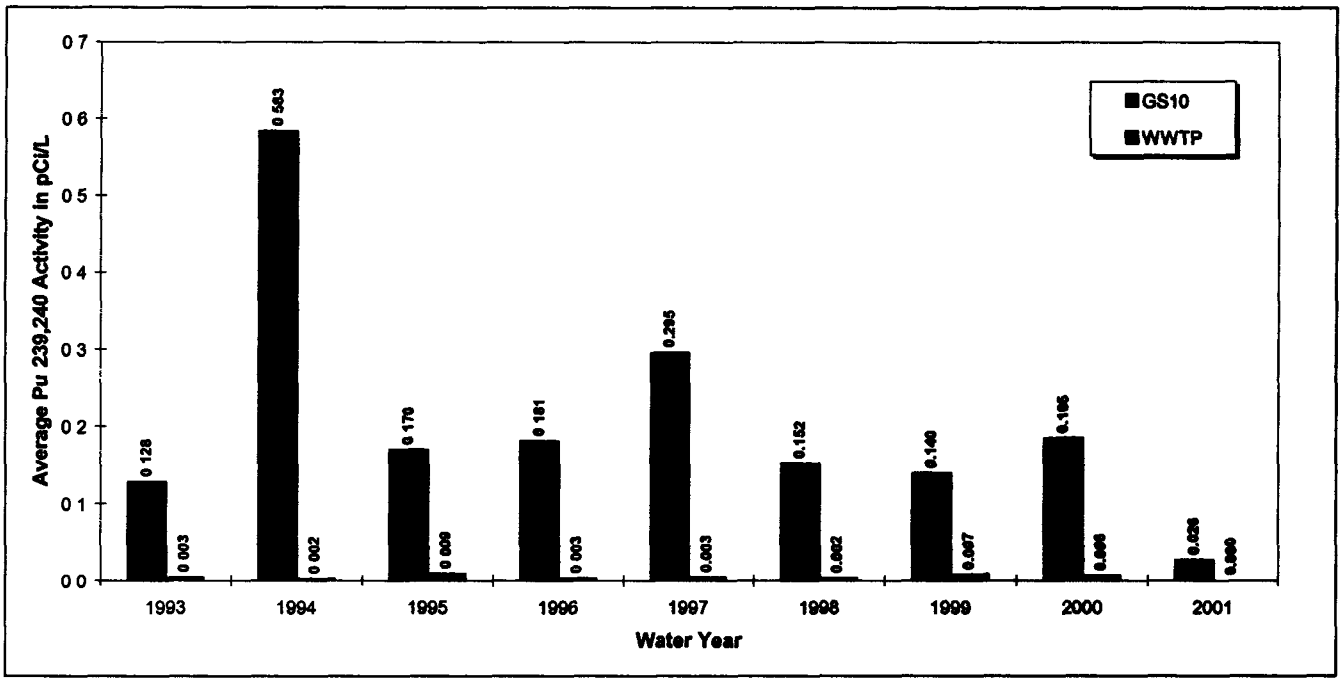
[14] These locations include GS01 GS02 GS04 GS06 GS33 GS35 GS41 GS42 SW022 SW027 and SW091

26



Notes Includes flow data from 10/1/92 – 2/28/01

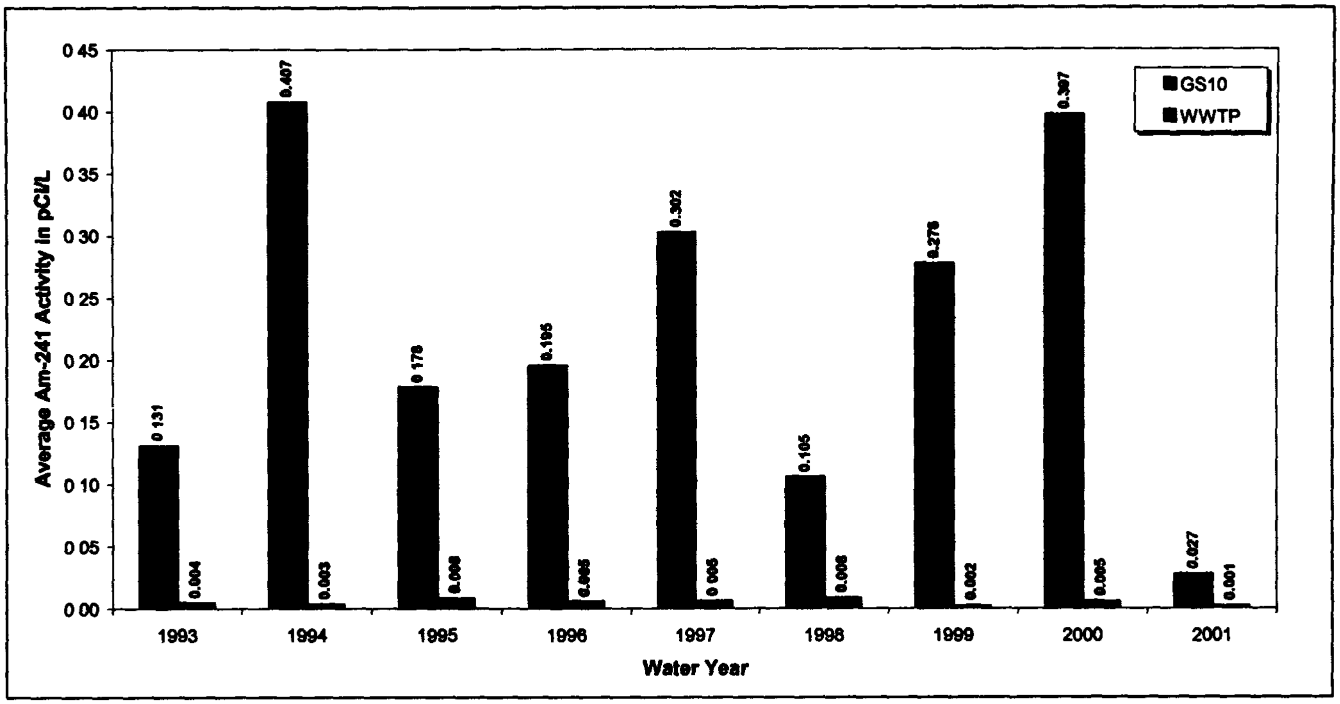
Figure 4 14 Relative Pond B-5 Inflow Volumes from GS10 and the WWTP



Notes For WY93 96 at GS10 alu shown s arithmetic average of sample results For WY97-01 at GS10 value shown is volume-weighted average acti ty for contin ous flow paced compos te samples (WY01 includes data through 3/26/01) For WY93 2000 at the WWTP value shown is the annual olume we ghted a erage of monthly sample results For WY2001 at the WWTP value shown is volume-weighted average activity for continuous flow paced composite samples (WY01 incl des data through 2/5/01)

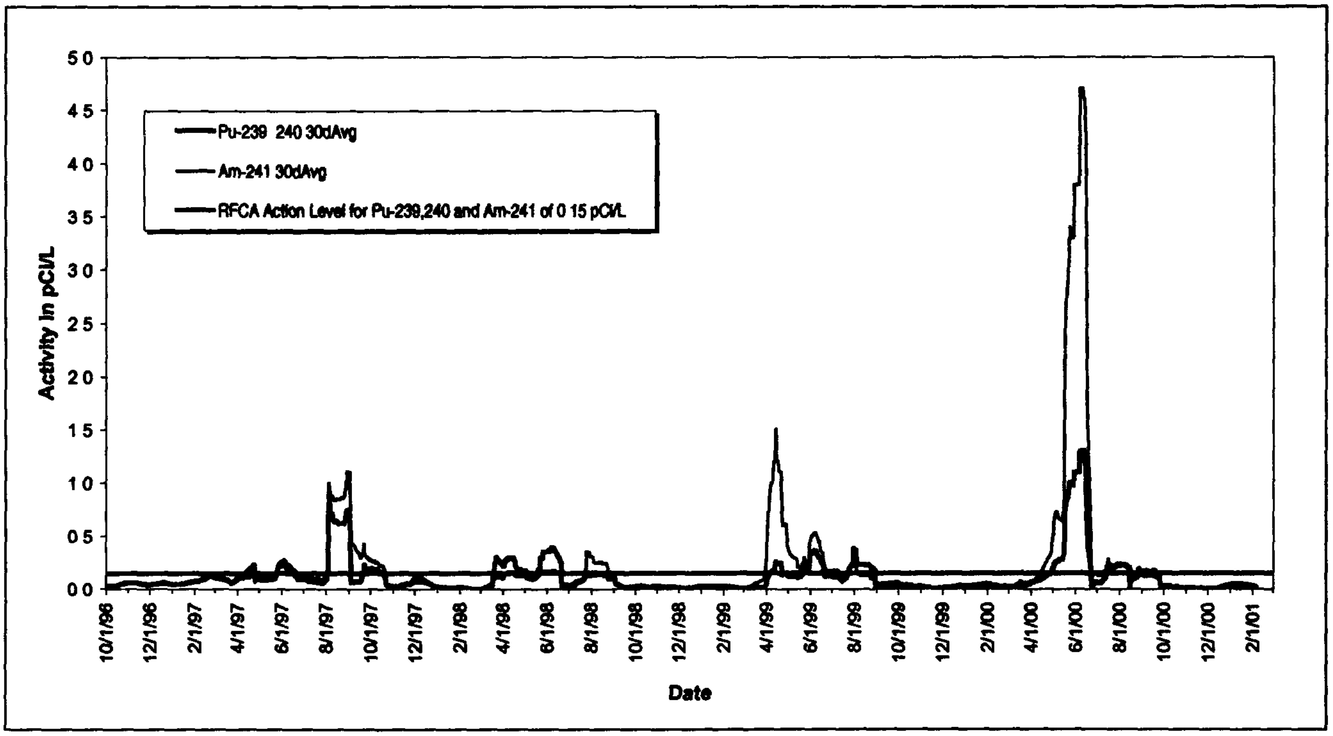
Figure 4 15 POE GS10 and WWTP Average Annual Pu Activities

27



Notes Activities calculated as for Figure 4-15

Figure 4-16 POE GS10 and WWTP Average Annual Am Activities

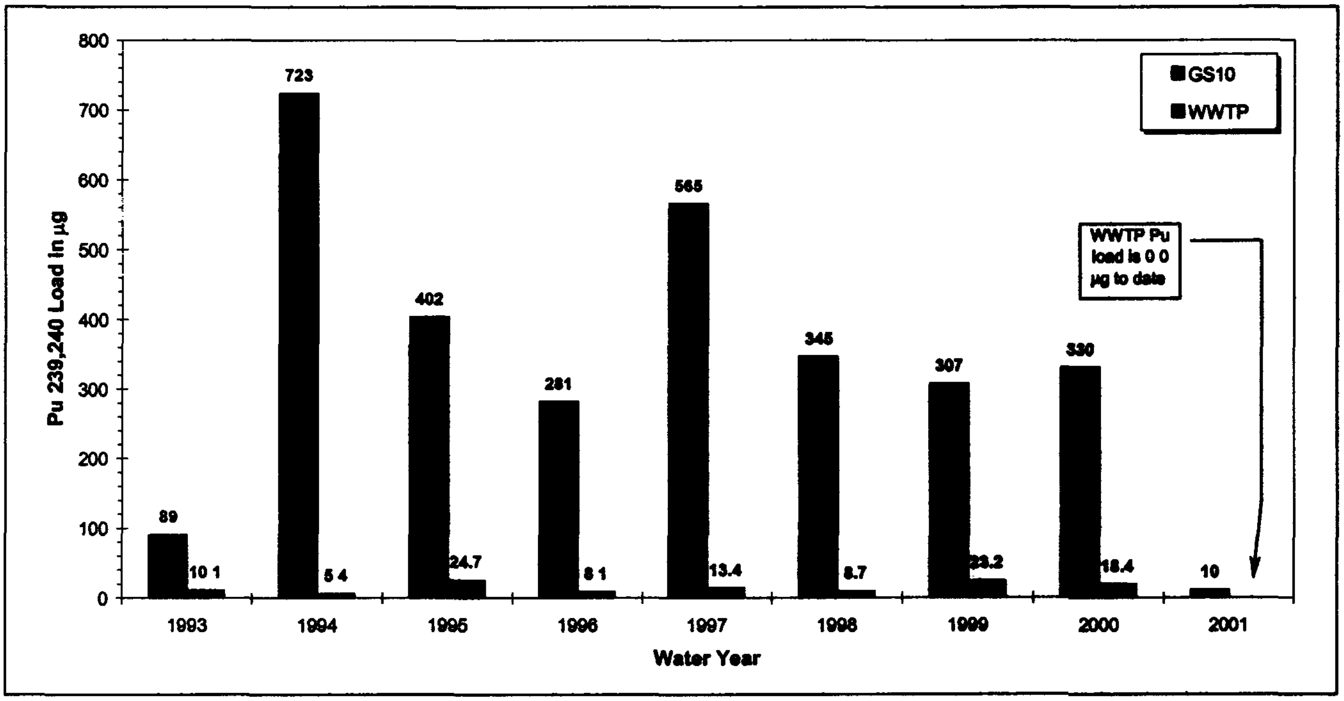


Note Data from 10/1/96 through 2/5/01

Figure 4 17 POE GS10 30-Day Volume- Weighted Moving Averages for Pu and Am Activities

28

Calculated Pu and Am loads at GS10 are generally 10-100 times higher than at the WWTP (Figure 4 18 and Figure 4 19) Prior to 2/99 water in Pond B 5 was routinely transferred to Pond A-4 before being batch discharged to lower Walnut Creek. Calculation of the corresponding Pu and Am load transfers is not possible because no measurements of activity were conducted and water volume measurements were inaccurate However after 2/99 B 5 was routinely direct discharged to lower Walnut Creek allowing for measurements of both flow and activity at GS08



Notes For WY93 96 at GS10 alue shown is calculated from the arithmetic average of sample results and the measured creek discharge For WY97-01 at GS10 alue shown s calculated from the volume-weighted average activity for each continuous flow-paced composite sample and the corresponding creek discharge (WY01 ncludes data through 3/26/01) For WY93-00 at the WWTP value shown is calculated from the monthly sample results and the measured efflue t discharge For WY01 alue shown is calculated from the volume weighted average activity for each continuous flow paced composite sample and the corresponding effluent discharge (WY01 includes data through 2/5/01)

Figure 4 18 POE GS10 and WWTP Calculated Annual Pu Loads

Figure 4 20 and Figure 4 21 show the B 5 influent and effluent loads for both Pu and Am.[15] Pond B 5 removal efficiency for Am is approximately 82% for the period and for Pu B 5 shows a removal efficiency of only 23% (Figure 4 22) However the two elevated samples from B 5 (6/23/99 0 603 pCi/L Pu and 8/11/00 0 864 pCi/L Pu) represent nearly 85% of the total Pu load from B 5

As discussed above it is unlikely that any overland flow occurred in the GS08 drainage area downstream of GS10 during the period including the 8/00 batch discharge from B 5 Therefore it is reasonable to assume that surface soil contamination from this area was not transported in surface water during the same period However it is possible that sediments could have been re suspended from the stream reach between GS10 and the outlet of B 5 This stream reach includes Pond B-4 S Walnut Cr between B-4 and B 5 and Pond B 5 Additionally sediments could have been re suspended by WWTP effluent flowing through Pond B 3 [16]

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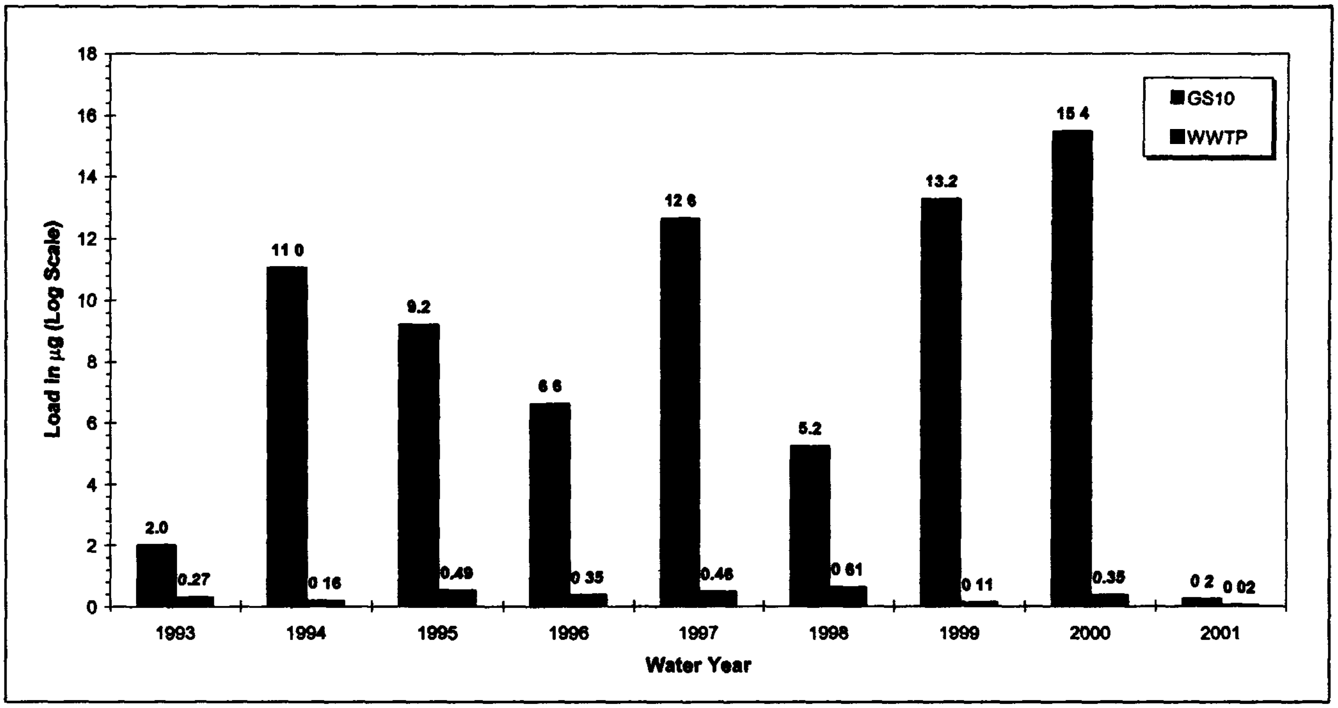
[15] Influent load is calculated from GS10 and WWTP data Effluent load is calculated from GS08 data Period of data is from 1/29/99 through 2/5/01

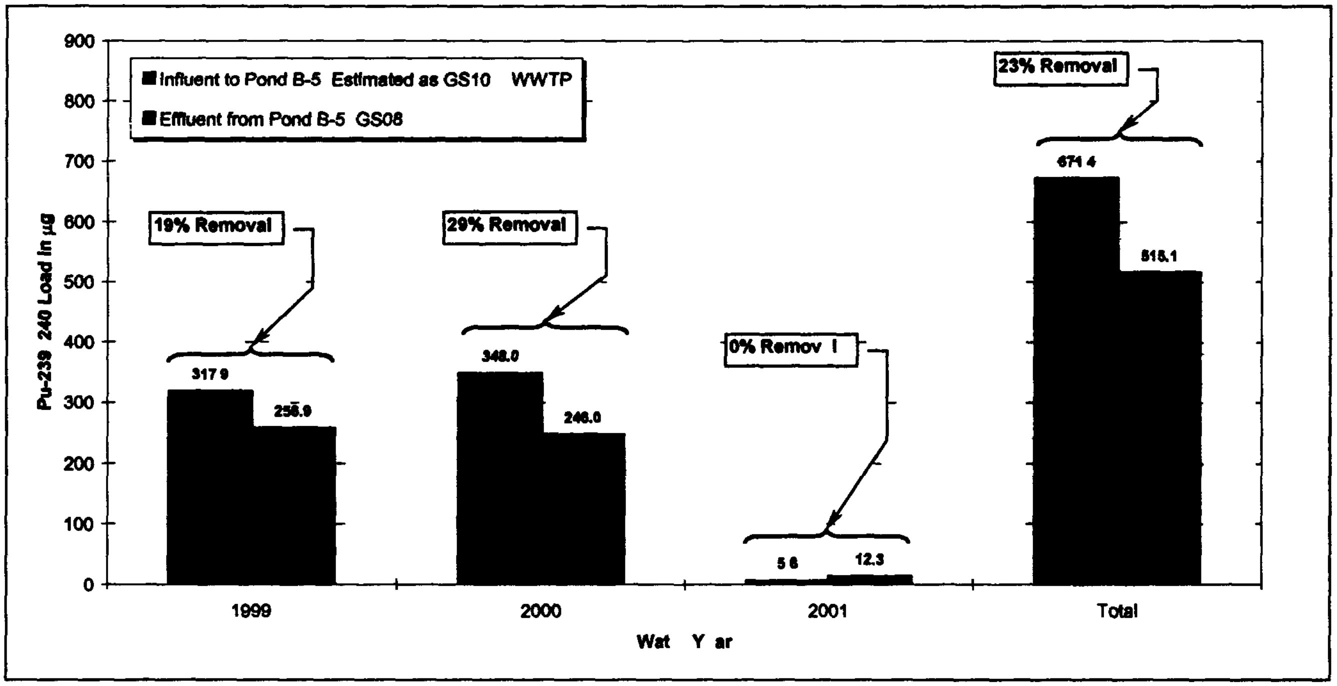
[16] Flows measured at GS10 are diverted to the south around Ponds B 1 B 2 and B 3 via the B 1 Bypass pipeline (Figure 4 23 Figure 2 3) WWTP effluent is conveyed via the WWTP pipeline to the north around Ponds B 1 and B 2 (Figure 4 23 Figure 2 3) to Pond B 3 Pond B 3 is currently batch discharged to B-4 during daylight hours

29



Notes Loads calculated as for Figure 4-18

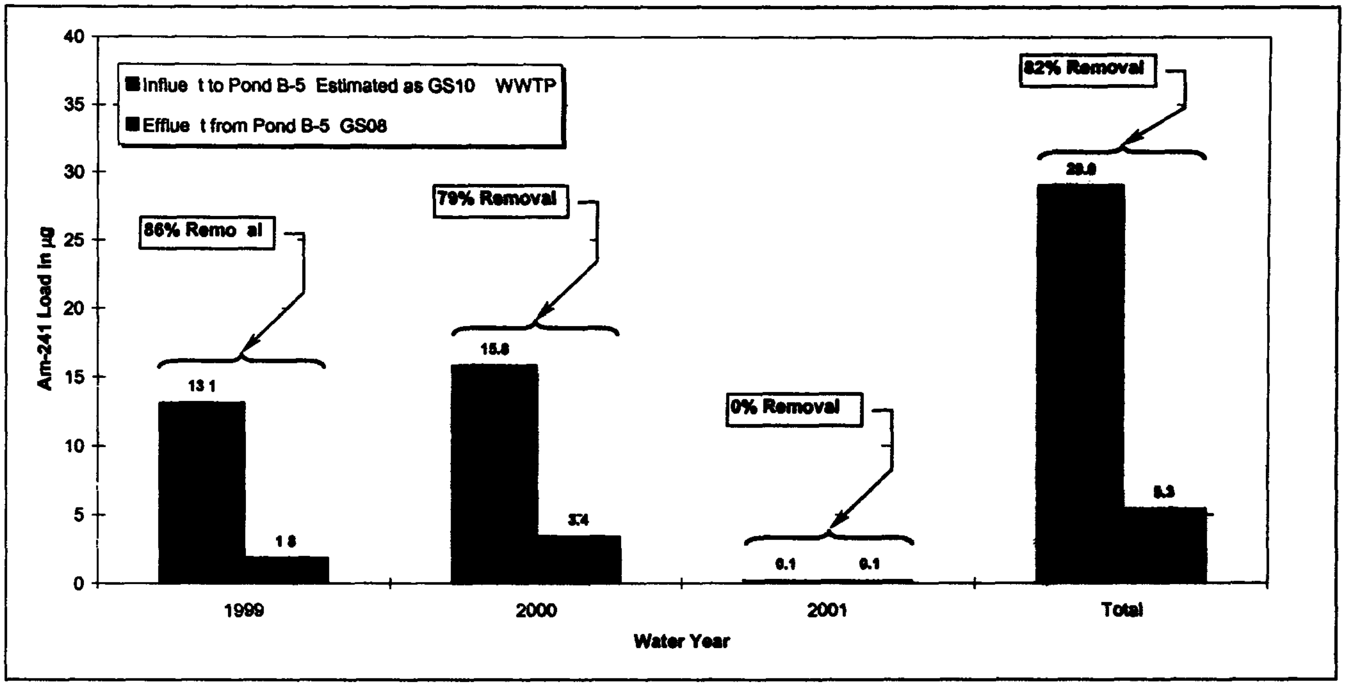
Figure 4 19 POE GS10 and WWTP Calculated Annual Am Loads



Notes WY99 loads are calculated after 1/29/99 when Pond B 5 transfers to Pond A-4 ceased WY01 load is through 2/5/01

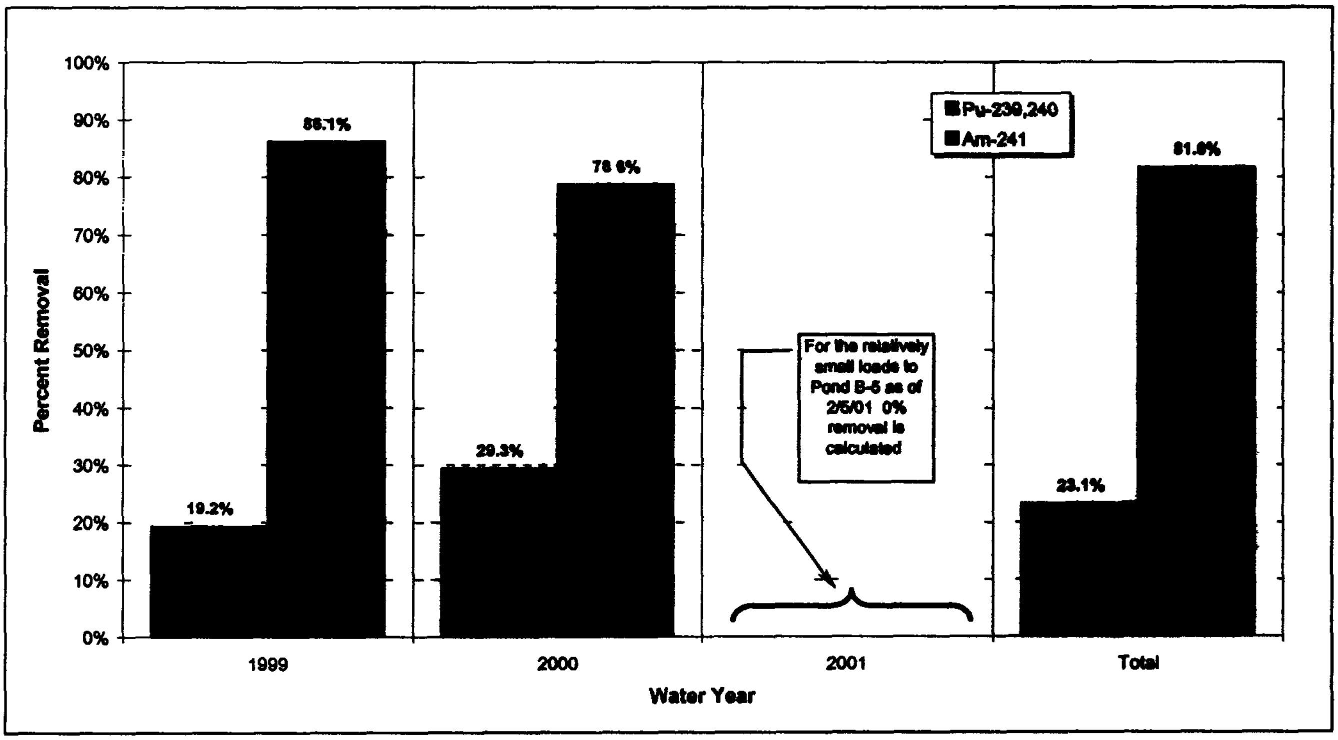
Figure 4 20 Annual B-5 Influent and Effluent Pu Loads

30



Notes WY99 loads are calculated after 1/29/99 when Pond B 5 transfers to Pond A-4 ceased. WY01 load is through 2/5/01

Figure 4 21 Annual B-5 Influent and Effluent Am Loads.

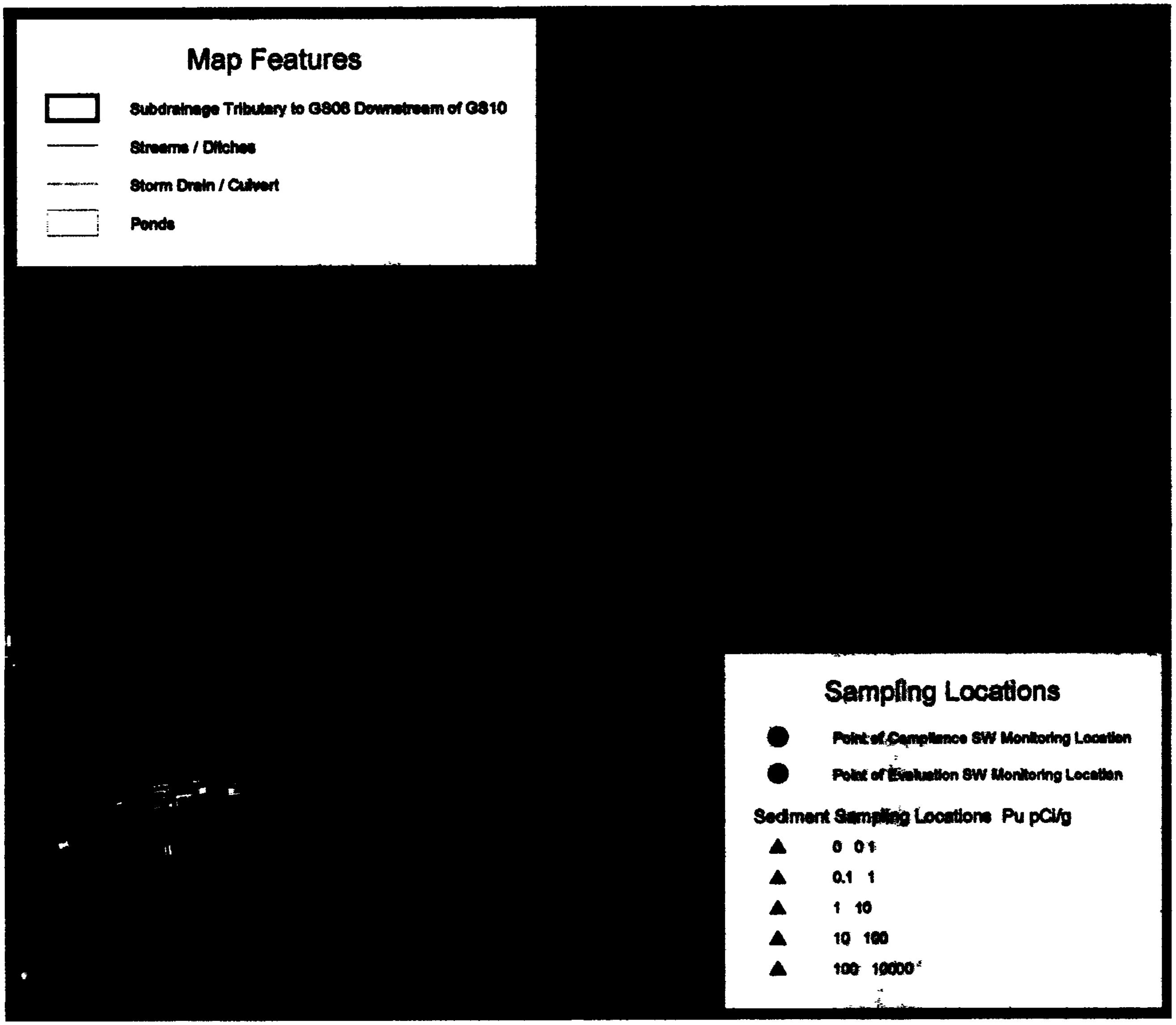


Notes WY99 remo al is based on loads calculated after 1/29/99 when Pond B 5 transfers to Pond A-4 ceased. WY01 removal includes loads through 2/5/01

Figure 4 22 Annual Pu and Am Removal Efficiency for Pond B-5

31

Sediment samples collected from Ponds B 3 and B-4 that showed elevated levels of Pu (Figure 4-23) Location specific sediment activities[17] in Pond B 3 range from 0 73 to 113 4 pCi/g Pu with an average for all locations of 32 pCi/g Pu Location-specific sediment activities in Pond B-4 range from 0 15 to 12 5 pCi/g Pu with the average for all locations being 4 3 pCi/g Pu Based on these sediment activities sediment resuspension from these ponds could provide Pu load to Pond B 5



Notes Sediment activity shown s arithmetic a erage activity of all samples by location

Figure 4-23 Average Pu Activity for Sediment Sampling Locations

Sediments in Pond B-4 could be resuspended by surface water flow from GS10 (Figure 2 3) The average activity of the TSS for RFCA surface water samples from GS10 is 2 0 pCi/g Pu (Figure 4 13) This activity is not significantly different from the B-4 sediment activities (nonparametric 50th percentile of 2 4 pCi/g Pu arithmetic average 4 3 pCi/g Pu) Additionally measurements of TSS activity for storm-event samples collected

[17] Location specific sediment activities are calculated as arithmetic averages of individual sample results by location

at GS09[18] (0 24 – 1 7 pCi/g Pu avg 1 0 pCi/g Pu) are generally lower than at GS10 To summarize data indicate that Pond B-4 sediments may not be significantly affecting surface water flowing through the pond

Sediments in the stream reach between B-4 and B 5 could be resuspended by surface water flows However sediment sampling locations in this reach (and Pond B 5) have low average activities ranging from 0 0 to 0 44 pCi/g Pu (arithmetic average of 0 21 pCi/g) These low activities are unlikely to significantly affect surface water quality especially given the low TSS measurements for B 5 discharge water

Sediments in Pond B 3 could be resuspended by effluent flow from the WWTP (Figure 2 3) TSS measurements from Pond B 3 show a range of 2 (half of 4 mg/L detection limit) to 380 mg/L with an average of 9 2 mg/L (Figure 4 24) TSS measurements from the WWTP effluent show a range of 0 75 (half of 1 5 mg/L detection limit) to 12 mg/L with an average of 2 6 mg/L (Figure 4 25) The histograms seem to indicate that there is an increase in TSS as the WWTP effluent moves through B 3 The Wilcoxon rank sum statistical test may be used to test for a shift in location between two independent populations that is the measurements from one population tend to be consistently larger (or smaller) than those from the other population Performing this test on the B 3 and WWTP TSS data indicate that the null hypothesis may be rejected at the 1 percent significance level suggesting that there is significant evidence of a TSS increase in Pond B 3

Both populations include a significant number of undetects (censored to the left) and estimations of the population means (especially for the WWTP ~95% undetect) is not possible with acceptable confidence However if the TSS of the WWTP effluent were to increase by 2 mg/L as the effluent volumes moved through B 3 an average annual estimated Pu load of 202 μg would be resuspended from B 3 sediments [19] This estimated B 3 load compares to 380 μg from GS10 (WY93-00 average) and 14 μg from the WWTP (WY93-00 average) This estimated load calculation gives an average estimated B 3 surface water activity of 0 068 pCi/L Pu [20]

Surface water Pu data from B 3 show a range of 0 003 to 0 15 pCi/L (arithmetic average of 0 042 pCi/L) However those data are from a limited time period 8/15/86-10/5/92 and may not be indicative of current water-quality conditions Additionally detection limits for data prior to 4/23/91 are at least 0 01 pCi/L Pu More recent data with lower detection limits show a range of 0 003 to 0 045 pCi/L Pu (arithmetic average of 0 015 pCi/L) Using the value of 0 015 pCi/L the estimated average annual Pu load from B 3 is 47 μg

This estimated B 3 load (47 μg) compares to 380 μg from GS10 (WY93-00 average) and 14 μg from the WWTP (WY93-00 average) Threfore depending on the actual resuspension rates in B 3 and the corresponding activity of the suspended material Pond B 3 may be contributing measurable Pu load to Pond B 5 The estimated B 3 Pu loads are between 12% and 53% of the loads measured at GS10

Sediment resuspension from Pond B-4 Pond B 5 and the stream reach between B-4 and B 5 is not expected to be a significant source of Pu load to B 5 discharge water Conversely sediment resuspension in Pond B 3 may be contributing measurable Pu load to Pond B 5 However current data do not allow for an accurate quantification of this load

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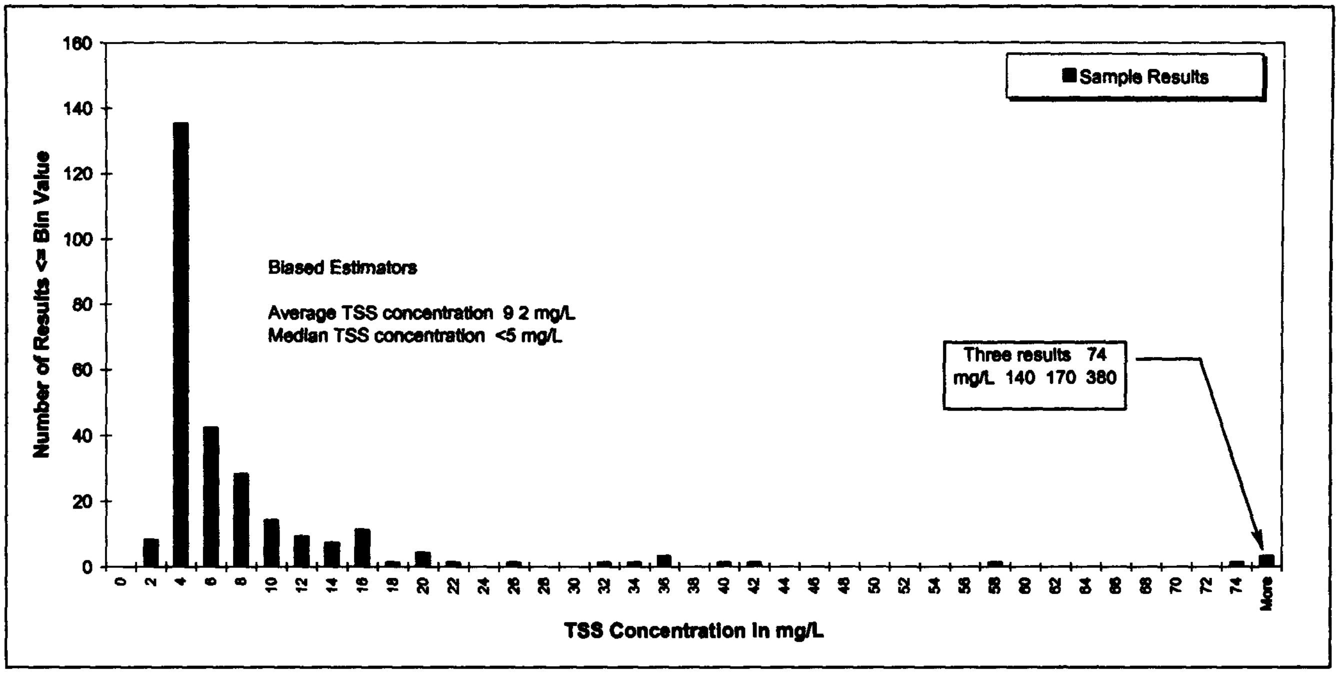
[18] GS09 is located on the outlet of Pond B-4

[19] This estimate assumes an average B 3 sediment activity of 32 pCi/g Pu (arithmetic average of location-specific activities 7 locations in B 3) The annual average WWTP discharge volume uses data from 10/1/92 3/31/01 (59 13 Mgals)

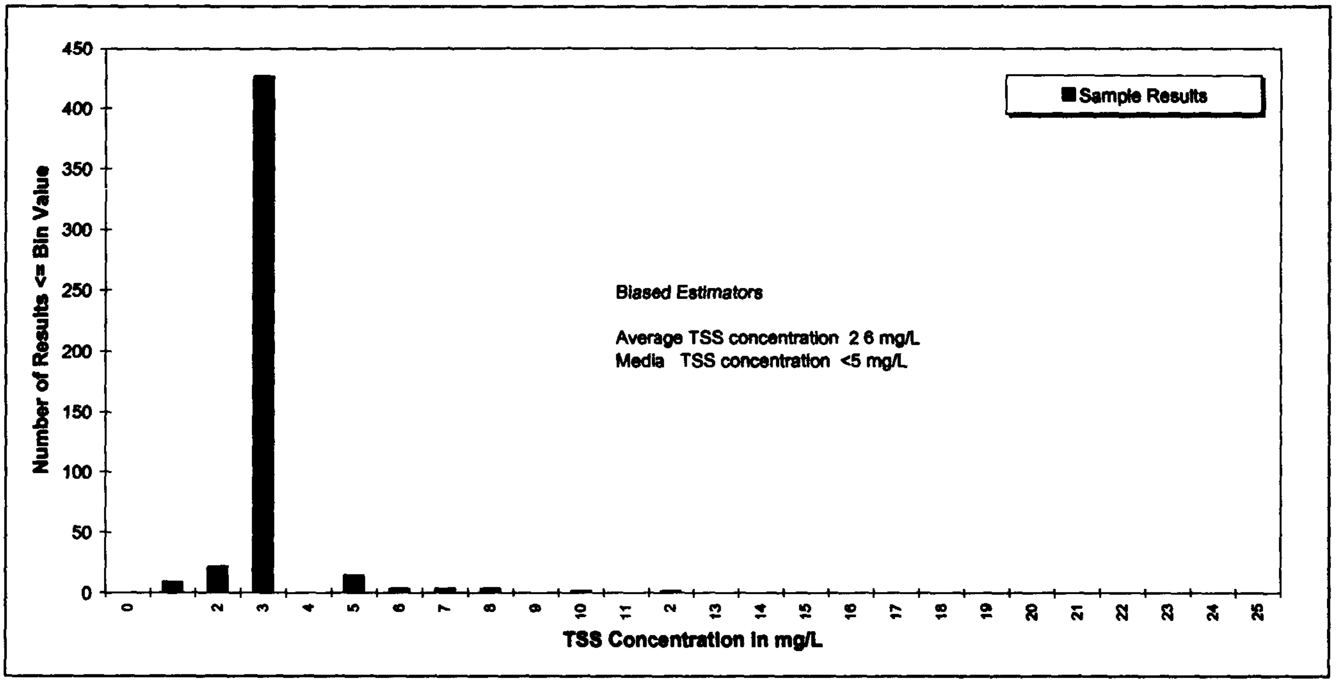
[20] Activity from resuspension estimated at 0 064 pCi/L arithmetic average WWTP activity 0 004 pCi/L Pu (WY93 3/11/01 data)

33



Notes Undetect values are set to half the detection limit Data from 10/1/96-10/26/00

Figure 4-24 TSS Distribution for Samples Collected from Pond B-3 (Location Code B3EFF)



Notes Undetect values are set to half the detection limit Data from 10/1/96-10/26/00

Figure 4 25 TSS Distribution for Samples Collected from the WWTP Effluent

4 5 Data Generated by Recent Site Projects

4 5 1 Facility Activities

Shift superintendent reports for June July and August 2000 were examined No occurrences were reported for the facilities within the South Walnut Creek drainage for the months examined

4 5 2 Environmental Remediation (ER) or Area Cleanup Projects

Site environmental remediation project managers were contacted and soil disturbance permit records were reviewed to determine if any projects may have been conducted during July and August 2000 that could have distributed contaminated soil in the South Walnut Creek drainage No soil disturbance permits were issued and no major environmental remediation activities were conducted in the lower South Walnut Creek drainage basin for the months examined

4 5 3 Probable Impacts of Site Activities Environmental Remediation or Cleanup Projects on Surface Water Quality of RFCA POC GS08

For the reasons discussed above it is concluded that recent D&D construction environmental remediation excavation and routine operations have not caused a release that resulted in the elevated plutonium activities measured at GS08

5 SUMMARY AND CONCLUSIONS

Site personnel have completed their initial source evaluation for potential cause(s) of reportable 30-day moving averages for plutonium at the POC monitoring location GS08 Site personnel completed an extensive evaluation of historical data and assessed Site activities and monitoring programs Site personnel conclude that the likely source of the reportable 30-day moving averages for Pu at GS08 is diffuse radionuclide contamination from past Site operations released to the environment through events and conditions over past years Based on the evaluation Site personnel conclude that no specific remedial action(s) is indicated at this time other than scheduled remedial actions for the Site (especially in the GS10 sub-drainage) as the source investigations have identified no other localized source(s) of contamination. The conclusions detailed in this report are summarized below

Based on the details regarding recent Site activities outlined in Section 4 5 it is concluded that neither D&D construction environmental remediation excavation nor routine operations caused a release that resulted in the elevated plutonium activities measured at GS08

Several facts concerning the August 11 2000 composite sample result which caused the reportable 30-day averages at GS08 cast uncertainty on the validity of the measurement

- Although the sample analysis did pass verification and validation the laboratory reported unusual difficulties in completing the analysis
- The magnitude of the result (0 864 pCi/L Pu) is the maximum result in the distribution for GS08
- The Pu/Am ratio of this result (20 1) is the maximum of the Pu/Am ratio distribution and the ratio is significantly higher than expected in Site surface waters
- The activity of the suspended solids of this sample (29 8 pCi/g Pu) is the maximum of the TSS activity distribution

Although the above specifics cast uncertainty on the validity of the August 11 2000 result this result may actually be a manifestation of a greater amount of spatial or temporal inherent variability than expected for Pu in surface water The existence of hot particles particle aggregation enrichment mechanisms, or other physiochemical / biochemical mechanisms may cause some samples to naturally have high actinide concentrations The multi-disciplinary studies associated with the AME are key to understanding water-quality variation on the Site and may eventually describe the extent and conditions under which Pu and Am move in the Rocky Flats environs

Based on the hydrologic conditions it is likely that the WWTP and the GS10 sub-drainage were the only sources of surface water flows included in the B 5 batch discharge volume during the reportable period Additionally the loading analysis indicates that GS10 contributes significantly more Pu load than the WWTP (annual average Pu load of 380 µg Pu from GS10 14 µg Pu from the WWTP) Therefore the GS10 sub drainage likely contributes a majority of the Pu load to Pond B 5

The sediment evaluation suggests that Pond B-4 Pond B 5 and the stream reach between B-4 and B 5 are not significant contributors of Pu load to surface water measured at the B 5 outfall (POC GS08) Conversely sediment activities in Pond B 3 are at levels that may adversely affect the Pu activities of the B 3 effluent However current data do not allow for an accurate quantification of any resuspended Pu load from Pond B 3

Site personnel are continuing the surface water source investigations using the existing monitoring program. The more rigorous GS10 source evaluation is ongoing with the latest GS10 report currently in production (RMRS 1997a 1997b 1997c 1998 1999 2000) Enhancements in monitoring activities may be implemented to provide improved resolution should any future reportable 30-day moving averages be measured at GS08

No specific recommendations for source control are proposed due to the reportable values measured at GS08 The recommended course of action will not compromise protection of human health and the environment since water-quality measurements at the Site boundary (POC GS03) showed levels of Pu well below the reporting threshold

DOE s proposed course of action includes (1) continuing observation (routine monitoring and special sampling as appropriate) and (2) continuing progress on the AME Effective best management practices such as the use of the existing terminal ponds in batch or flow through mode to clarify stormwater of potentially-contaminated sediment and particulate matter should also be continued Specifically DOE and the Kaiser Hill Team propose the following actions as the path forward

- Continued observation (routine monitoring and special sampling as appropriate to the evaluation) and ongoing data interpretation to provide better understanding of actinide transport directly related to the operation of the Site automated surface water monitoring network. This monitoring and the associated evaluations (especially related to GS10) will be valuable should reportable values be measured in the future
- Continued progress on the AME as a longer term technical study to provide increased understanding of actinide migration and insight to the cause(s) and possible prevention of reportable radionuclide water quality measurements This multi-disciplinary study and the associated watershed modeling initiative is key to understanding water-quality variation on the Site and may eventually describe the extent and conditions under which plutonium and americium move in the Rocky Flats environs Site personnel expect these efforts may provide insights about the cause(s) and possible prevention of reportable radionuclide water quality measurements
- Continued use of the existing detention ponds in batch or flow through mode as an effective best management practice to clarify stormwater containing potentially contaminated sediment and particulate matter
- Continued progress reporting through AME reports Quarterly RFCA Reports Quarterly State Exchange Meetings and informal status/flash briefs

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6 REFERENCES

Chapra S C Canale R P 1988 *Numerical Methods for Engineers* 2nd Edition McGraw Hill Inc New York New York.

Chow V T Maidment D R and L W Mays 1988 *Applied Hydrology* McGraw Hill Inc New York, New York

Gilbert R O 1987 *Statistical Methods for Environmental Pollution Monitoring* Van Nostrand Reinhold New York New York

Hunt W F et al 1981 *U S Environmental Protection Agency Intra Agency Task Force Report on Air Quality Indicators* EPA-450/4 81-015 Environmental Protection Agency National Technical Information Service Springfield VA

Iman R L and W J Conover 1983 *A Modern Approach to Statistics* John Wiley & Sons New York, New York

K H and RMRS 2000 *Report on Soil Erosion/Surface Water Modeling for the Actinide Migration Evaluations at the Rocky Flats Environmental Technology Site* Prepared by Kaiser Hill L L C and Rocky Mountain Remediation Services L L C for U S Department of Energy Rocky Flats CO August 2000

Povetko O G K A Higley 2000 Study of Particles of Actinides in Soil Samples Using Nuclear Track Detectors *Health Physics Society 2000 Conference Denver CO August*

Ranville J F and Honeyman B D 1998 *Actinide Content and Aggregate Size Analyses for Surface Soils in the Walnut Creek and Woman Creek Watersheds at the RFETS* Report to Kaiser Hill Company Colorado School of Mines Golden CO

RMRS 1997a *Progress Report #1 to the Source Evaluation and Preliminary Mitigation Plan for Walnut Creek* Revision 1 RF/RMRS 97-089 UN Kaiser Hill Company Golden Colorado September

RMRS 1997b *Progress Report #2 to the Source Evaluation and Preliminary Mitigation Plan for Walnut Creek* RF/RMRS 97 115 UN Kaiser Hill Company Golden Colorado November

RMRS 1997c *Progress Report #3 to the Source Evaluation and Preliminary Mitigation Plan for Walnut Creek* Revision 2 RF/RMRS 97 115 UN Kaiser Hill Company Golden Colorado December

RMRS 1998 *Final Report to the Source Evaluation and Preliminary Mitigation Actions Plan for Walnut Creek* RF/RMRS 98 234 UN Kaiser Hill Company Golden Colorado April

RMRS 1999 *Source Evaluation Report for Point of Evaluation GS10* RF/RMRS 99 376 Golden, Colorado July

RMRS 2000 *Sampling and Analysis Plan for Automated Synoptic Surface Water and Sediment Sampling for the GS10 Source Investigation* Revision 0 Golden Colorado March

Santschi P H Roberts K and Guo L September 30 2000 *Final Report on Phase Speciation of Pu and Am for Actinide Migration Studies at the Rocky Flats Environmental Technology Site* Texas A&M University Galveston TX 47p

U S Environmental Protection Agency 1989 *Statistical Analysis of Ground Water Monitoring Data at RCRA Facilities Interim Final Guidance* Office of Solid Waste Management Division Washington D C April

Figure 1-1
Location Map for
RFCA POC GS08

EXPLANATION

SW Monitoring Location Typ

- Po f Evalu o
- Po f C mpli nce
- GS08 S bdr nag
- GS10 S bdr nage

Standard Map Features

- Buld g d the st cture
- Dem lish d buld g
- Sol Evapo io Po d (SEP)
- Lake d po d
- Stream , ditch , othe dr nag feat
- Fenc d othe ba rs
- Topog aph C ntou (20 Foot)
- Paved ad
- D rt road

Scale 77
Inch represents approximately eet

State Plane Coordinate Projection
Colorado Centr Zone
Datum NAD27

U S Department f Ene gy
Rocky Flat E vironmental Technology Site

GIS Dept 303-966-7707

Prepared by:
DynCorp

Prepared for
KAISER HILL

MAP ID: 01-0409

May 21, 2001

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